GW - 28

GENERAL CORRESPONDENCE

YEAR(S): 1985

DISCHARGE PLAN
NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO
REFINERY

July 31, 1985

Prepared for:

David Griffin
Navajo Refining Company
P.O. Drawer 159
Artesia, New Mexico 88210

Prepared by:

Geoscience Consultants, Ltd.
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Geoscience Consultants, Ltd.

July 31, 1985

RECEIVED

AUG 8 1985

OIL CONSERVATION DIVISION

Mr. Richard Stamets
Energy and Minerals Department
Oil Conservation Division
P.O. 2088
Sante Fe, New Mexico 87501

RE: Discharge Plan Application For Navajo Refining Company
Artesia New Mexico Facility

Dear Mr. Stamets:

On behalf of Navajo Refining Company, Geoscience Consultants, Ltd. is pleased to submit the Discharge Plan Application for Navajo's Artesia New Mexico facility. A substantial change in the regulation of the surface impoundments under The Resource Conservation and Recovery Act (RCRA) has necessitated a corresponding change in the proposed methods for wastewater management. Section 7.0 of this document addresses the effect of these proposed regulations on the discharge plan.

A second substantial development has also occurred in the past few weeks. Chemical anaylses conducted by the New Mexico Environmental Improvement Division has resulted in NMEID classifying Pond Evaporation Lagoon #1 as a hazardous waste surface impoundment. It is not economically realistic for Navajo to maintain Pond #1 as a hazardous waste surface impoundment; therefore, Navajo has elected to close this surface impoundment pursuant to RCRA. To address both these issues, biological treatment of wastewaters generated at the facility will be implemented prior to 1988. Biological treatment will substantially improve the character of the effluent discharged at Navajo.

Section 7.0 outlines the options that Navajo will be pursuing toward biological treatment of wastewaters. We anticipate that technical staff from NMOCD, NMEID and the Navajo will be working closely together within the next few months to determine a schedule for the implementation of wastewater treatment at Navajo's Artesia facility as well as closure plans for Pond #1. We would like to meet with NMOCD and NMEID in September concerning this matter.

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Please note that Figures 4-7 and 4-9 have been revised and are submitted with this document; other figures submitted with the original submission remain unchanged. If you should have any questions regarding this submission or require more information please contact me.

Very Truly Yours,
GEOSCIENCE CONSULTANTS, LTD.

Randall T. Hicks
Vice President

RTH/pe/STAME001.LTR
Enclosures
cc: Mr. David Griffin, Navajo Refining Company
Peter Pache, NMEID

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REGULATORY INDEX

WQCC REGULATION REQUIRED IN DISCHARGE PLAN	SECTION IN DISCHARGE PLAN
1-201	1.0
1-202	To be submitted
3-105.F	7.1.1
3-106.C.1	5.3, Appendix D
3-106.C.2	6.0, 7.0, 8.0
3-106.C.3	4.3, 4.4
3-106.C.4	4.5
3-106.C.5	Figure 5.1
3-106.C.6	4.1, 4.2, 4.3
3-106.C.7	9.0
3-106.C.8	Not Applicable
3-107	8.0
3.108.B	1.0
3.108.B.3	5.2

1.0 EXECUTIVE SUMMARY

Navajo Refining Company, P.O. Drawer 159, Artesia, New Mexico, 88210 proposes to implement biological treatment of wastewater at the Artesia Refinery and discharge approximately 405,200 gallons per day of oil refinery wastewater to the Pecos River. The refinery is located in Section 9,T. 17S. R. 26 E. and the 85 acre evaporation ponds are located in Section 12,T.17 S, R. 26 E. Wastewater from the process units flows through an oil/water separator to remove hydrocarbons discharged with the wastewater. The refinery's effluent has a total dissolved solids content of 2000-4000 mg/l. The ground water near the evaporation ponds is at a depth of 8 feet with a background total dissolved solids content of about 15,000 mg/l. In the refinery area the "shallow aquifer" (upper Queen Formation), which is at a depth of 150 to 250 feet below land surface, exhibits nearly 100 feet of artesian head. The total dissolved solids content of the ground water in this aquifer is about 500-1000 mg/l. About 15 feet below land surface a 2 to 5 foot thick water-bearing unit is present in the Refinery area. This unit exhibits some artesian pressure and has a total dissolved solids content of about 1500 mg/l. Biological treatment of wastewater will substantially improve the quality of wastewater at the facility.

2.0 LOCATION AND PHYSIOGRAPHY

2.1 LOCATION

The Navajo Refining Company's plant facilities and wastewater management system are located in and near the town of Artesia, in Eddy County, New Mexico. The refinery's processing plant and much of the waste management system is located within the city limits, in the west 1/2 of Section 9, T. 17 S., R. 26 E. The associated wastewater evaporation facilities are located in Sections 1, 2, 9, 10, 11, and 12 of T. 16 S., R. 26 E., and in part of the west 1/2 of Section 6, T. 16 S., R. 27.E. (Figure 2-1).

2.2 PHYSIOGRAPHY

Artesia lies in the Eastern Plains of New Mexico; a broad, flat plateau with a local elevation of 3300 to 3400 feet above sea level. Topography in the Artesia area slopes gently (15 to 20 feet per mile) to the east, and is drained by the nearby Pecos River (Figure 2-1). The region is semiarid, with rainfall averaging less that 11 inches per year. Soils are typically of the Arno, Harkley, Pima and Karro associations, developed by deep weathering of bedrock or old alluvium (USSCS, 1971).

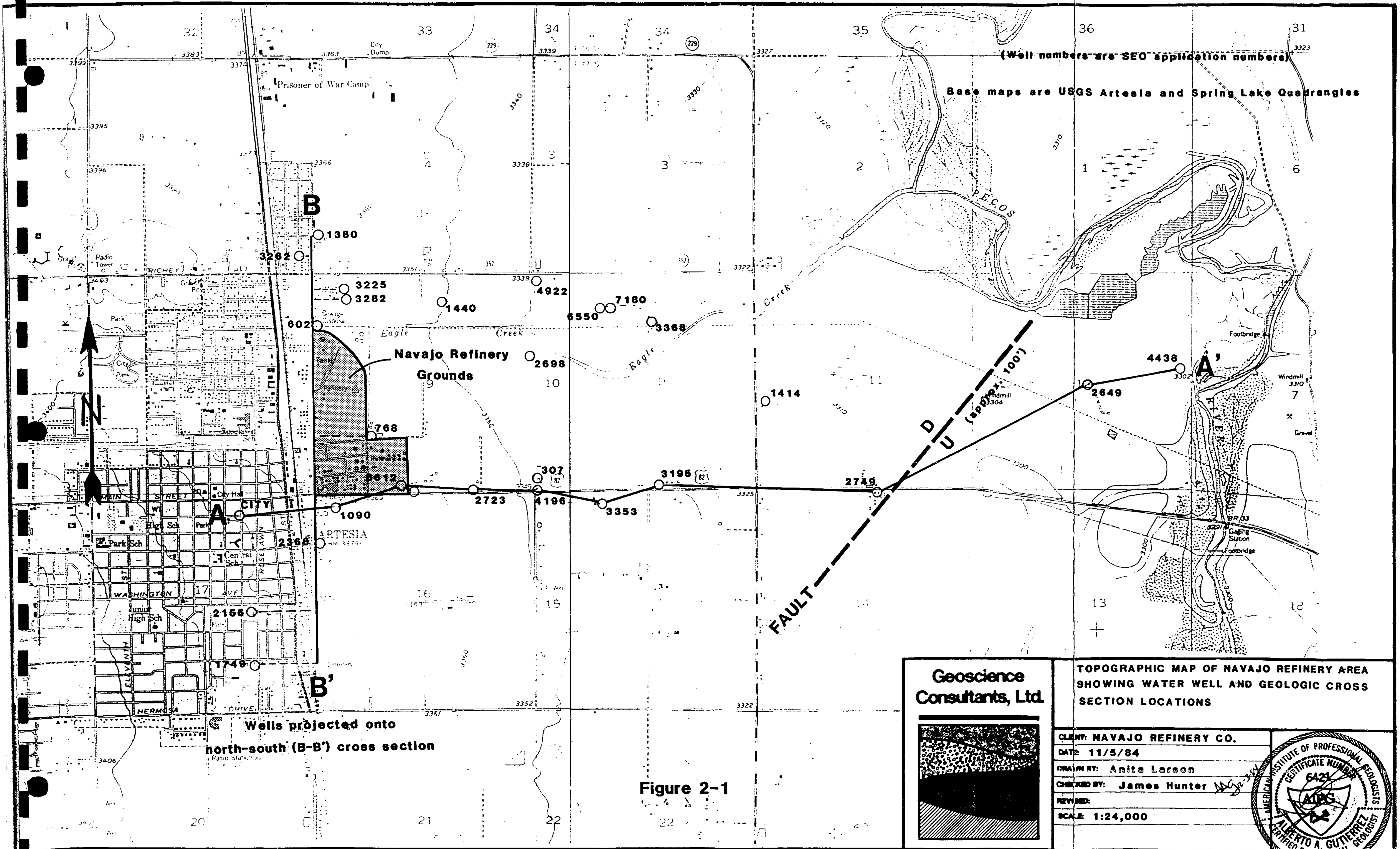


Figure 2-1

Geoscience Consultants, Ltd.

TOPOGRAPHIC MAP OF NAVAJO REFINERY AREA SHOWING WATER WELL AND GEOLOGIC CROSS SECTION LOCATIONS

CLIENT: NAVAJO REFINERY CO.
DATE: 11/5/84
DRAWN BY: Anita Larson
CHECKED BY: James Hunter
REVISED:
SCALE: 1:24,000

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS — CERTIFICATE NUMBER 6421 — AIPG — ALBERTO A. GUTIERREZ — CERTIFIED PROFESSIONAL GEOLOGIST

3.0 BRIEF HISTORY OF OPERATION

The refinery began operations in the 1920's. The technology, size and ownership of the facility have changed numerous times since commencement of crude processing. Until 1969, the North Division and the South Division were operated by Conoco. Navajo then purchased both units and began to further integrate the operation into a single refinery capable of processing New Mexico sour crude (an asphalt-based crude with a high sulfur content) in the South Division and New Mexico intermediate crude (a paraffinbased crude produced mainly from the Abo Formation) in the smaller North Division.

Since the 1970's Navajo has constructed over 50 monitor wells and product-recovery wells to address the environmental concerns at the facility. The installation of four product-recovery trenches has resulted in a significant reduction in the total amount of hydrocarbons which exist in soil. Hydrocarbon product recovery will continue and, if necessary, be expanded to insure environmental protection.

Ground-water monitor wells are also in place throughout the refinery to assist in delineating soil contamination by hydrocarbons, for RCRA monitoring of landfarms and other RCRA disposal facilities, and to monitor the integrity of the waste conveyance and evaporation facilities. In addition to ground water monitoring, Navajo maintains a strict manifest and record-keeping system. This system helps to insure that all waste is handled and disposed of properly. This system is in compliance with all applicable RCRA regulations.

4.0 DESCRIPTION OF PHYSICAL ENVIRONMENT AT SITE

Four water-bearing units are present beneath the Navajo Refining Company facility:

- The San Andres Formation
- The upper Queen Formation
- Alluvium in the Pecos River Valley
- Small, discontinuous perched-water aquifers in the Seven Rivers Formation

The San Andres and upper Queen formations are the principal aquifers of the Artesia area (Welder, 1983). The San Andres, locally called the deep or artesian aquifer, has been extensively developed for industrial, municipal and agricultural purposes. This unit is under considerable artesian pressure. The upper Queen in the Artesia area is principally used for individual domestic wells, but some larger capacity wells completed in this unit are employed for irrigation. Unlike the "shallow" aquifer in the Roswell area, water-bearing sand units in the upper Queen exhibit artesian head. Adjacent to the Pecos River a third water-bearing unit is present: the Pecos River Valley alluvium. This unit is not currently utilized in this area for any purpose because of its poor water quality. Within the Seven Rivers Formation isolated permeable sands and fractured evaporites will produce small quantities of poor quality water. These isolated units may show a few feet of artesian head. One such unit is present about 15 feet below the Refinery. The evaporation ponds and portions of the conveyance ditch lie on the flood plain of the Pecos River and Eagle Draw. However, numerous flood control structures upstream from Navajo have eliminated most of the flooding potential of the facility.

4.1 GEOLOGY

The town of Artesia and the Navajo site are underlain by thin (20 feet or less) layer of soils, alluvium and weathered bedrock, which generally conceals subcrops of the Artesia Group (Permian). As seen in the explanation of Figure 4-1, the Artesia Group consists of carbonates, evaporites and shales deposited in a backreef environment. The Artesia area is located on the northwestern shelf of the Permian Basin and basinward (southeasterly) stratigraphic dips of 1 to 3 degrees are typical.

Structure in the Artesia area is expressed as gentle (1-3 degree) southeasterly dips, with few other features. One fault (inferred from subsurface data) is mapped in the area. This fault trends about N. 40 E. through sections 11, 12 and 14 (Figure 4-1), and is apparently a normal fault with the northwest block downthrown. This structure parallels the other major structural elements of this area, such as the Y-O and K-M "buckles" or fault zones (Kelley, 1971).

In Section 12, the fault appears to pass beneath the Navajo Refining Company's evaporation ponds near the Pecos River. Although the fault may cut across all known and potential aquifers, there are several reasons why the fault is not a potential conduit for ground water contamination. First, faults in evaporites (Queen, Seven Rivers) typically "heal" or self-seal by flowage and recrystallization of gypsum and anhydrite. Second, the net hydrostatic head of the shallow and deep artesian aquifers is upward and would prevent any downward flow.

4.2 GEOMORPHOLOGY AND SOILS

The Artesia region is located on a broad, gently sloping plateau which has developed as a result of <u>in-situ</u> weathering of flat-lying carbonate and evaporitic bedrock. Localized areas of valley fill (Pecos River Valley and major arroyos) form the only other significant substrate for soil formation. Within soil series formed on a particular substrate, soil properties vary as a result of differing grain size, land slope and available moisture. Figure 4-2 shows the distribution and properties of soil types in the Artesia area. The Navajo plant site is located

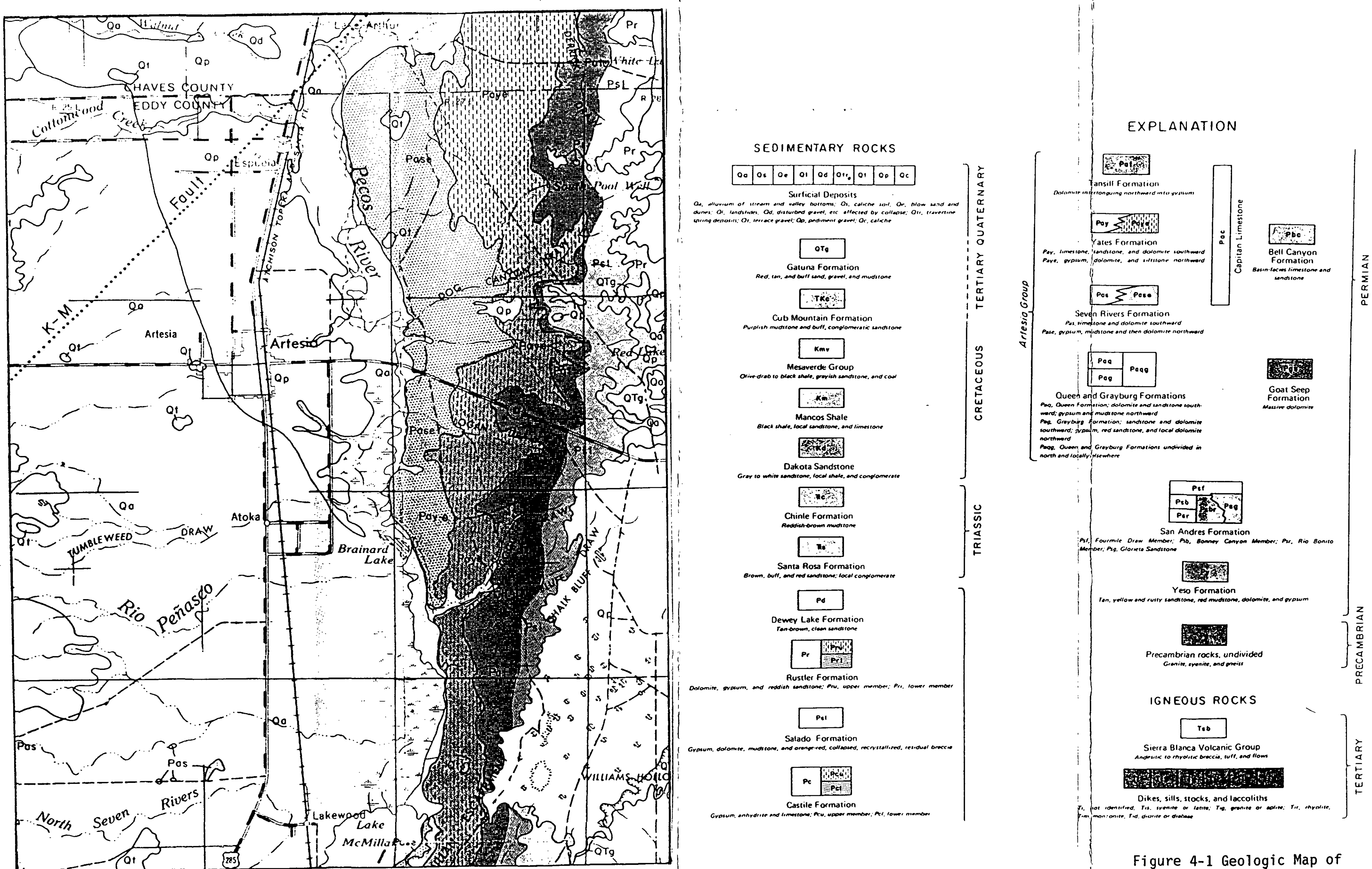
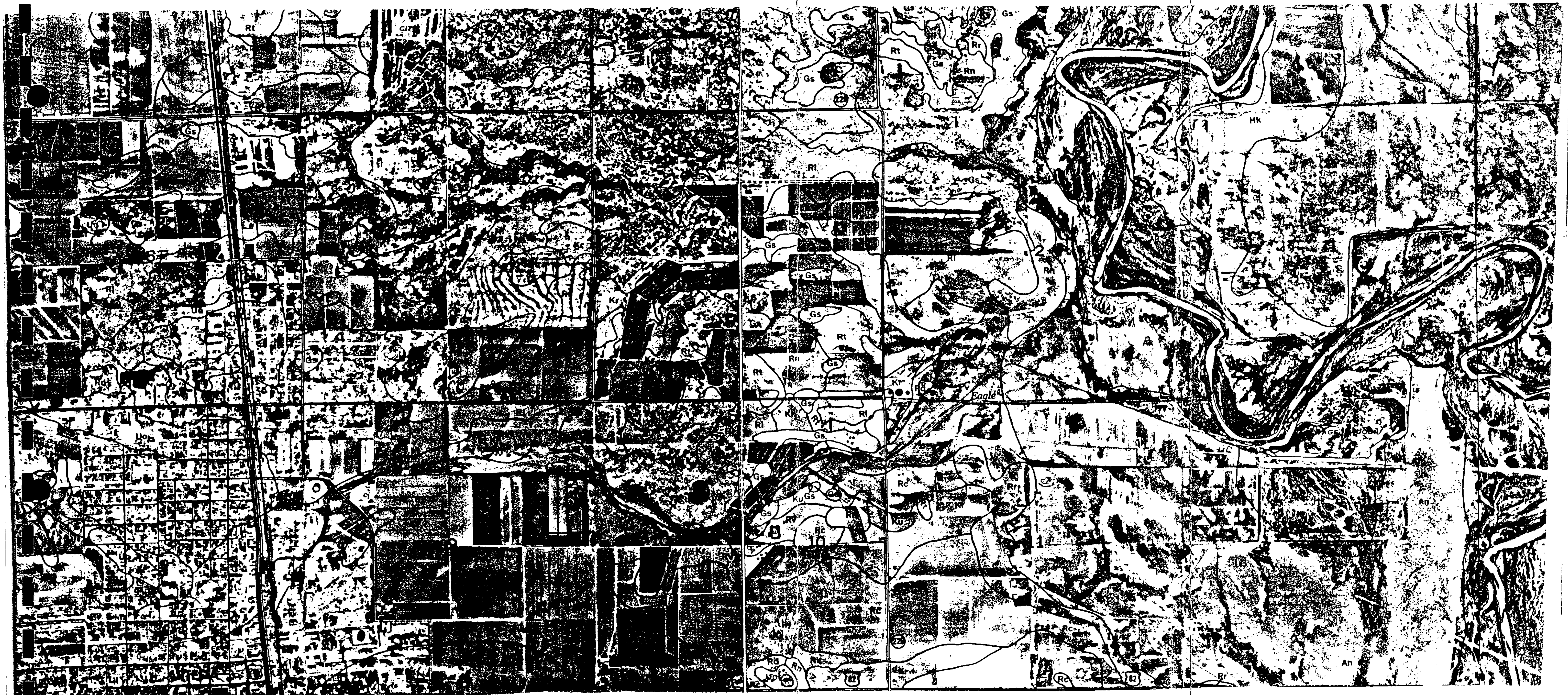


Figure 4-1 Geologic Map of Artesia area

4-3



Soil series and map symbols	Depth to bedrock, hard caliche, or gypsum	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO	Percentage passing sieve- No. 4 (1.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permea-bility	Available water capacity	Reaction	Electrical Conductivity ($Ec \times 10^3$)	Corrosivity (Untreated Steel pipe)	Shrink-swell potential
Arno: AH, Ak, An (For Harkey part of AH and Ak, see Harkey series).	More than 60.	0-14	Silty clay loam	CL	A-6	100	100	90-95	0.05-0.20	0.18-0.20	7.9-8.4	4.0-8.4	High	Moderate
		14-60	Silty Clay	CH	A-7	100	100	90-95	0.05-0.20	0.15-0.17	7.9-8.4	8.0-12.0	High	High
Harkey: Ha, Hk	More than 60.	0-87	Very fine sandy Loam, Loam and silt loam.	ML	A-4	100	100	60-75	0.8-2.5	0.17-0.19	7.4-7.8	2.0-12.0	Moderate to high	Low
Karro: KA, KL, Kr, Ku, KV	More than 60.	0-20	Loam	ML-CL	A-4	100	100	60-75	0.8-2.5	0.16-0.18	7.9-8.4	4.0-10.0	High	Moderate
		24-60	Clay loam	CL	A-6	100	100	70-80	0.8-2.5	0.18-0.20	7.9-8.4	8.0-15.0	High	Moderate
Pima: PM, Pe, Pn, Pv	More than 60.	0-60	Silt loam to silty clay loam	CL	A-6	100	100	85-95	0.2-0.8	0.18-0.20	7.4-7.8	0-4.0	Moderate	Moderate

Figure 4-2 Characteristics and distribution of soils in Artesia area.

in an area of Karro Loams (USSCS, 1971). These soils are developed on deeply weathered calcareous rocks, and are moderately permeable. Much of the refinery site area has been filled, graded and leveled, leaving little natural soil in place.

The effluent ditch (Figure 2-1) parallels Eagle Creek, and is constructed in soils of the Pima Series. These dark, calcareous loams develop on carbonate bedrock and carbonate-rich alluvial material. They are moderately permeable and have a high water-holding capacity.

The evaporation ponds are built on soils of the Arno Series which develop on fine, silty alluvium in the Pecos River Valley. These soils have low permeability and high waterholding capacity.

4.3 REGIONAL GEOHYDROLOGY

The Artesia area is located in the Roswell-Artesia artesian water basin (Welder, 1983). The two principal ground water reservoirs are the artesian San Andres aquifer, and two shallow aquifers (Queen Formation and valley alluvium). Local, perched water-bearing units with small storage capacity also occur in isolated stratigraphic traps. With the exception of some wells located in valley alluvium immediately adjacent to the Pecos River, all wells in the Artesia area exhibit some degree of artesian head. Deep (800-1200 feet) artesian wells are completed in the Grayburg-San Andres formations, and have static water levels 50 to 80 feet below ground level. The deep aquifer is confined by shales and evaporites of the lower Queen Formation. Shallow aquifer wells (150-250 feet) produce from the upper sands of the Queen Formation, and are confined by aquitards of anhydrite, gypsum and shale in the overlying Seven Rivers Formation (Figure 4-3). Water levels in shallow wells range from 40 to 60 feet below ground level.

Regionally, some wells tap the shallow, perched "gyp water" reservoirs in stratigraphic traps in the upper Seven Rivers Formation. These waters are effectively isolated from both major aquifers. Even in very shallow wells (20 feet) these perched zones exhibit 3 to 5 feet of artesian head.

The regional potentiometric surfaces of the deep and shallow aquifers are shown in Figures 4-4 and 4-5. The two potentiometric surfaces have very similar elevations (about 3300' msl), with the deep artesian aquifer's surface slightly above the shallow aquifer's surface.

Both aquifers produce water for irrigation, industrial and domestic purposes. Water quality is variable from 500 to over 5000 ppm total dissolved solids, and in general the more saline waters are found at greater depths and/or to the east.

4.4 GROUND WATER HYDROGEOLOGY

The deep artesian aquifer is the major source of ground water in the Artesia area and supports most of the large local agricultural industry. Artesian water, of quality ranging from 500 to over 5000 ppm TDS, is found in the San Andres and Grayburg formations (Permian) at depths of 850 to 1250 feet below the surface (Kelley, 1971). This aquifer system is recharged along San Andres outcrops in the Sacramento Mountains west of Artesia. In the early 1900's many wells in this aquifer flowed 1000 to 3000 gallons per minute (gpm), but extensive withdrawals have lowered the head to about 50 to 80 feet below the land surface (Figure 4-4). The artesian aquifer is confined by the impermeable (or very slightly permeable) carbonates, shales and evaporites which comprise much of the overlying Queen and Seven Rivers formations (Figure 4-3). Its potentiometric surface is typically slightly above the shallow aquifer's upper surface (Welder, 1983).

The shallow aquifer, which has been described as a "water table" aquifer, is in fact a second artesian aquifer. With the exception of wells drilled immediately adjacent to the Pecos River nearly all shallow aquifer wells exhibit 100 to 150 feet of artesian head. Shallow wells typically produce from sands in the upper Queen Formation at depths of 150 to 250 feet. These sands are confined by the thick anhydrites and shales (aquitards) of the overlying Seven Rivers Formation. Relatively impermeable shales and evaporites several hundred feet thick separate the upper Queen sands from the underlying San Andres.

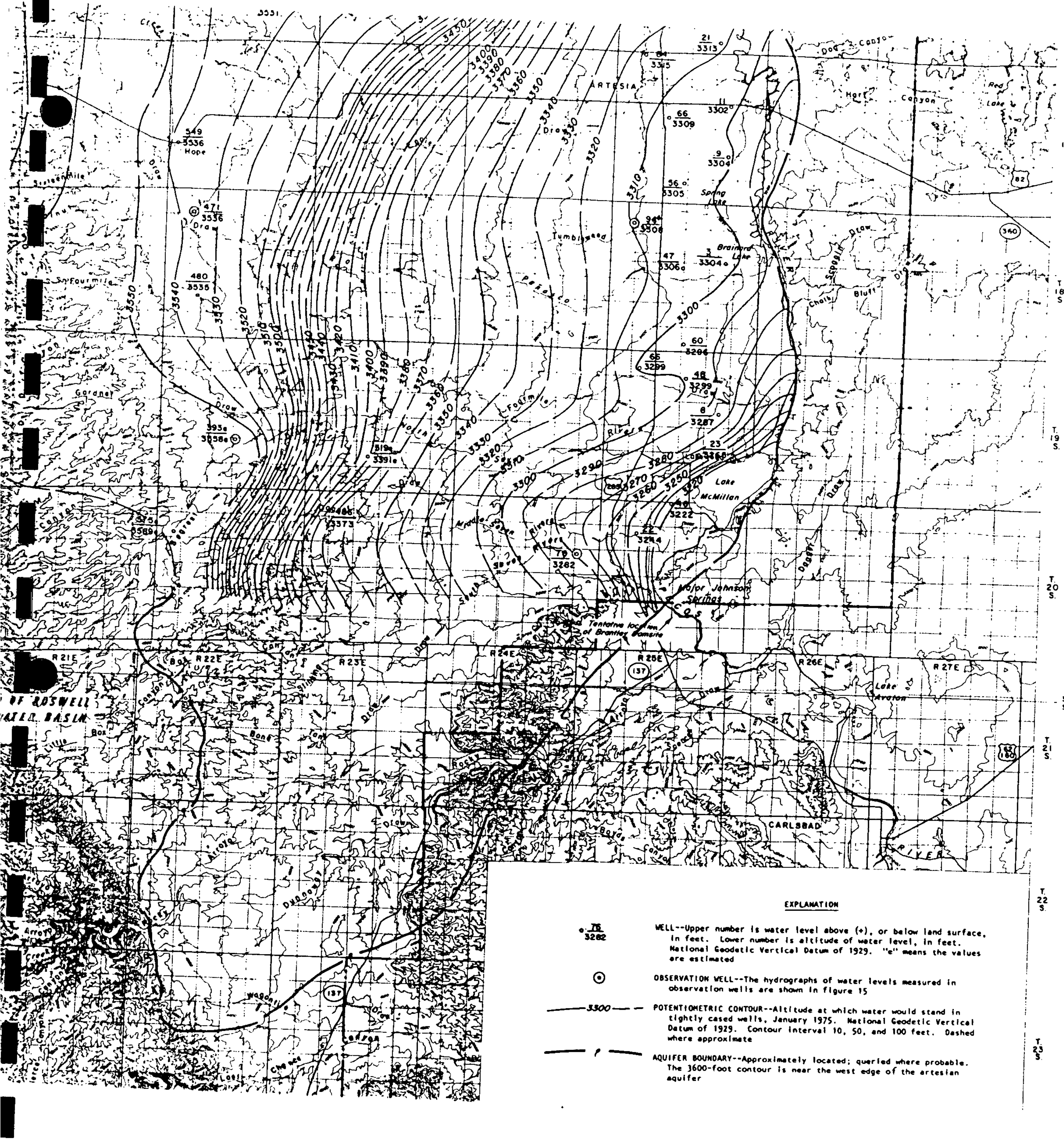


Figure 4-4 Potentiometric surface of deep aquifer (Welder, 1983)

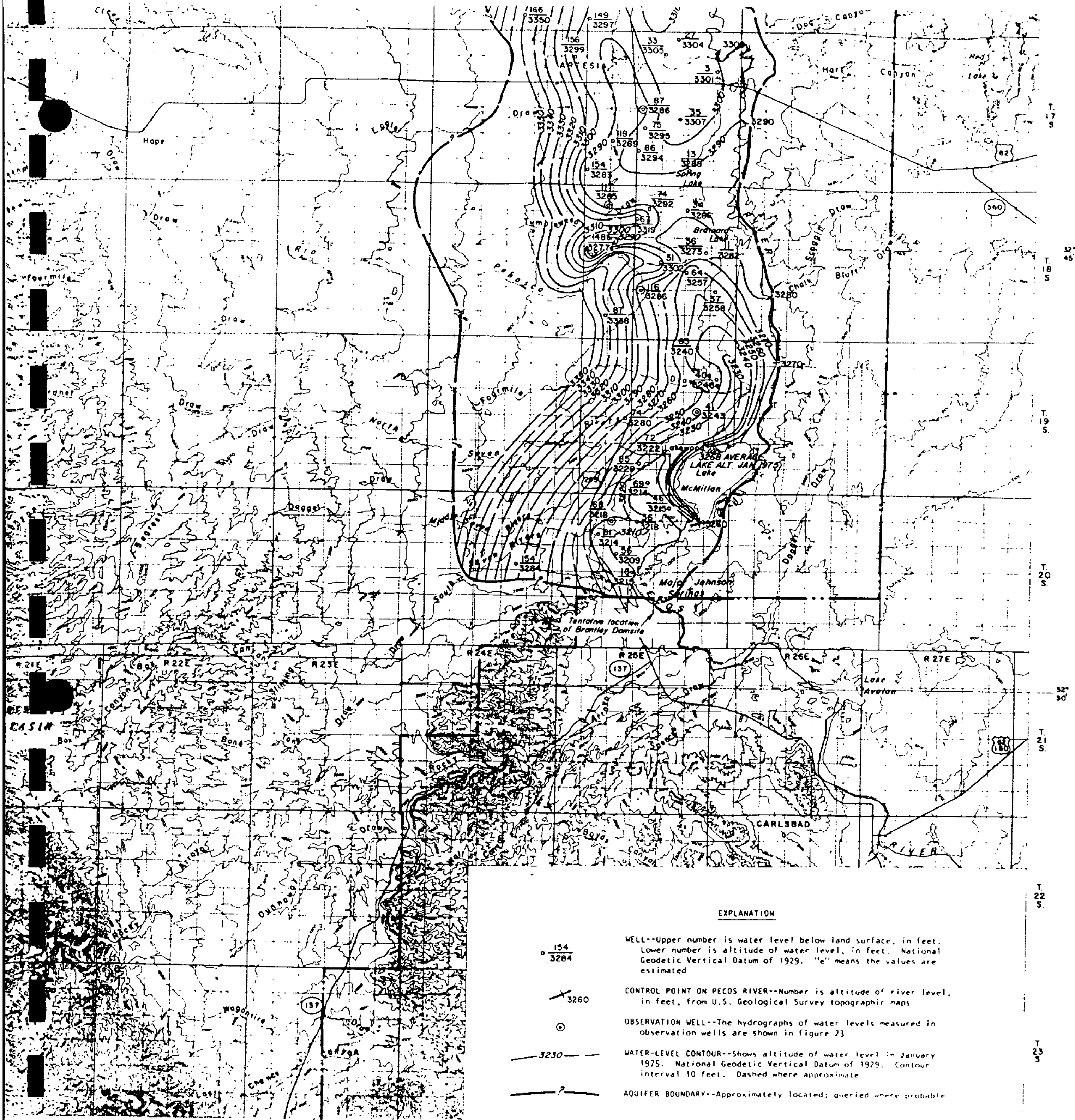


Figure 4-5 Potentiometric surface of shallow aquifer (Welder, 1983)

Analysis of driller's and geophysical logs (Appendix A) shows that the Navajo site is underlain by evaporites, carbonates and shales of the Seven Rivers Formation. These rocks are nearly impermeable, with the exception of local, isolated bodies of sand and fractured anhydrite. Only minor amounts of ground water is found in or produced from the Seven Rivers Formation. Cross sections illustrating the hydrogeologic relationships of the shallow aquifer are shown in Figure 4-3.

At depths of approximately 200 to 250 feet, the uppermost sands of the Queen Formation are encountered. These sands contain and produce usable amounts of ground water, and constitute most of the shallow aquifer in this area. These sands are 10 to 50 feet thick, and lie at the top of about 700 feet of relatively impermeable carbonates and evaporites which comprise the bulk of the Queen.

A map of the shallow-aquifer potentiometric surface (Figure 4-5) shows that it typically slopes gently to the east and southeast, and follows the regional stratigraphic dips. South of the Artesia area, where extensive agricultural development exists, the potentiometric surface forms a trough due to significant withdrawals from the shallow aquifer. The shallow-aquifer's potentiometric surface is generally slightly below the artesian aquifer's potentiometric surface, indicating that any interconnection (along faults or poorly completed wells) would cause flow upward from the deep to the shallow aquifer. The configuration of the shallow aquifer is locally complicated by large, seasonal irrigation withdrawals. Although considerable local variation is observed, the shallow aquifer generally provides water of quality adequate for domestic and irrigation use (500-1500 ppm TDS).

In some areas there is evidence for the existence of an isolated, discontinuous perched-water aquifer, which lies on top of clay or anhydrite lenses above the confined shallow aquifer. Very shallow (10-30 feet), low-production wells may have tapped this "gyp water" in the past and used the production for stock. Many of these wells have been abandoned for a variety of reasons including exhaustion of water or poor quality. These small, stratigraphically-trapped accumulations of ground water are highly variable in areal extent, volume, saturated thickness and quality. One such confined body of water underlies part of the Navajo facilities.

The configuration of the perched-water unit under the Navajo site is revealed by over 40 monitor wells, installed by Navajo Refining Company. Lithologic drillers logs show that water is encountered in weathered and fractured anhydrite (so called gypsum sand) at depths of 15 to 30 feet, and typically rises to levels 3 to 5 feet above the saturated unit (Appendix A). This water-bearing unit is confined above by layers of gypsum, anhydrite and caliche, and below by a continuous layers of clay and anhydrite. Figures 4-6 and 4-7 illustrate the geometry and hydrology of the plant site area.

These Figures show that this perched gypsum/anhydrite/sand unit is comprised of several water-bearing zones at different depths. The water-bearing zones are generally less than 5 feet thick and are typically hydraulically connected. However, wells #19 and #34, and #29, #37, #39 and #40 show that anomalies in the potentiometric surface are present due to complex hydraulic connections in some areas of the plant.

Navajo Refining Company maintains 3 evaporation ponds near the Pecos River, which are connected to the plant site by a conveyance channel paralleling Eagle Creek (Figure 2-1). These ponds, and the portions of the conveyance channel in Sections 12, 11 and the E 1/2 of 10 are located in Pecos valley alluvium. Monitor wells installed by Navajo show that ground water in the valley alluvium is typically 6 to 12 feet below the surface. Although the alluvium is generally silty sand, some 6 inch monitor wells can maintain a pumping rate of 10-15 gpm indicating the presence of lenses of higher permeability material. Figures 4-8 and 4-9 show the configuration of the water surface in this unit. As expected, flow is sub-parallel to the Pecos River Valley, generally flowing toward the River. The water level in this unit should respond to the fluctuations of flow in the River (Figure 4-10). Therefore, during periods of high flow the hydraulic gradient is from the river to the

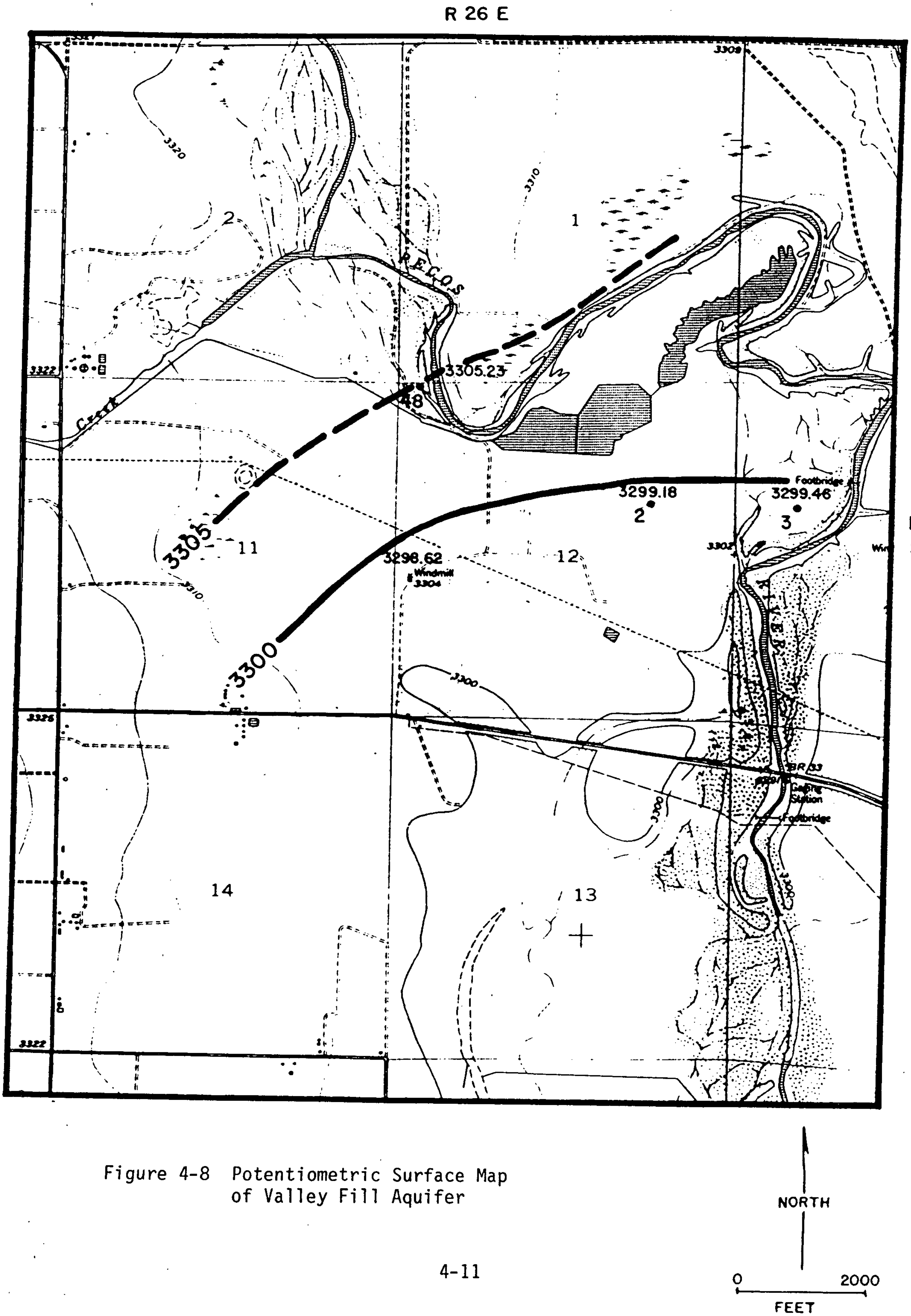
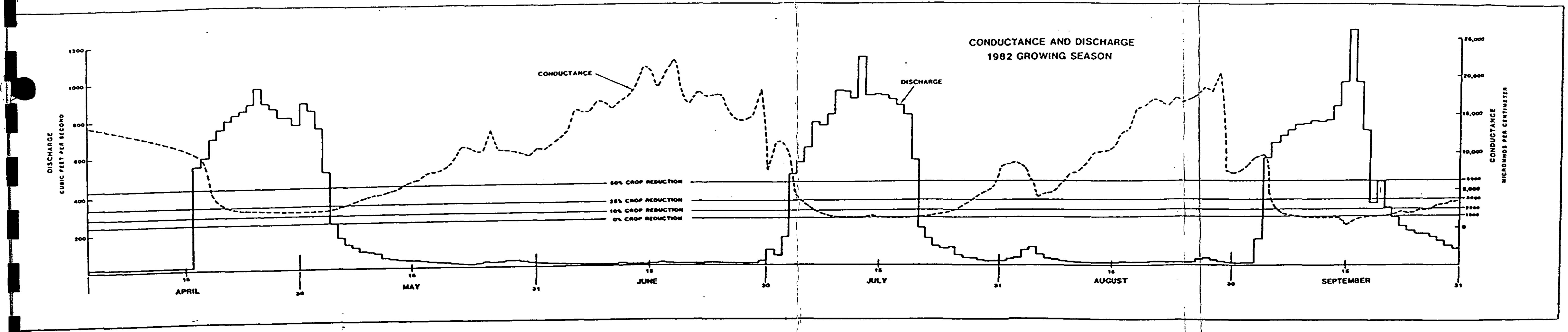


Figure 4-8 Potentiometric Surface Map of Valley Fill Aquifer



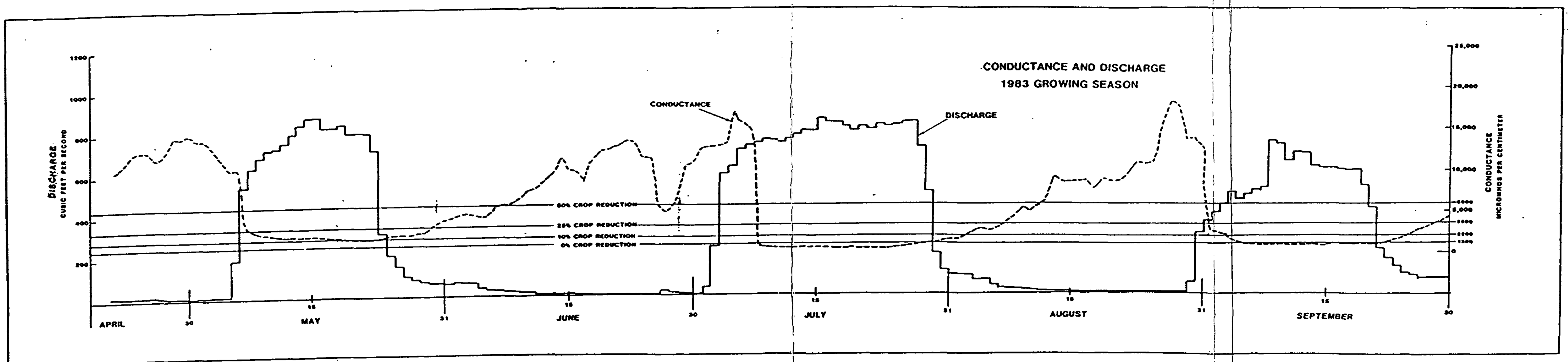


Figure 4-10 Relationship between conductance and discharge in Pecos River near Artesia (unpublished data from USGS).

alluvium and the Pecos River loses water. During low flow periods the gradient is reversed.

4.5 SURFACE WATER HYDROGEOLOGY AND FLOODING POTENTIAL

Artesia lies in the eastern plains of New Mexico on a broad, mature plateau developed on flat-lying bedrock. The city is at an average elevation of 3380 feet (msl) on an essentially featureless plain which slopes eastward at about 3 feet per mile (0.35 degrees). Surface drainage is typically controlled by small, ephemeral creeks and arroyos which flow eastward into the Pecos River. These small drainages are subparallel and spaced at about 0.75 to 1.5 miles.

The major drainage in the immediate Artesia area is Eagle Creek which runs from west to east through the city, northeast through the Navajo Refinery and then eastward to the Pecos (Figure 2-1). Eagle Creek's channel has been rectified (artificially formed and straightened) from west of Artesia to the Pecos. Discussions with the City of Artesia Engineer (Mr. John Brown) indicate that there is no historical record of Eagle Creek overflowing its banks. However, such an overflow could occur in a 100 year event (5.0 inches of precipitation). To deal with this problem, the city is continuing its efforts at rectifying Eagle Creek and plans to construct a check dam several miles west of Artesia within 2 years. These measures will effectively remove Artesia and the Refinery from the 100-year floodplain.

The evaporation ponds and parts of the conveyance ditch lie in the geologic floodplain of the Pecos River. In the past, large releases from upstream reservoirs coupled with high rainfall events have resulted in minor damage to the conveyance ditch. The ponds are located on alluvial material next to the Pecos. Pond perimeters are 16 to 18 feet above the river channel, and the largest pond is protected by a 5-foot high dike. Analysis of historic records of Pecos floods (Patterson, 1965; USGS unpublished data 1946-1983) shows that a maximum stage height of 17.4 feet was reached on September 30, 1932. Is is unlikely that this level will ever be equalled, owing to the construction of several flood-control dams (Alamogordo, Los Esteros) on the upper Pecos. No discharge event since

1941 has exceeded the 13.76 foot stage (25,200 cfs on October 8, 1954) and no discharge since 1960 has exceeded 7000 cfs. Modern "floods" in the Pecos are now controlled releases of water for irrigation, and these discharges are deliberately controlled to prevent any actual or potential flooding of lands and structures adjacent to the Pecos. Any release or rainfall event large enough to flood the evaporation ponds would effectively dilute the effluent to a level far below stream or ground water standards.

4.6 GROUND WATER QUALITY

Four separate hydrogeologic units are present at the Navajo facility:

- the artesian aquifer (San Andres)
- the shallow aquifer (upper Queen)
- the Pecos River Valley alluvium, and
- the perched water in the terrace regolith and surficial deposits.

The well-defined pressure regime in the confined aquifers (San Andres and the upper Queen) demonstrates that these units cannot be degraded by surficial sources (Section 4.4). Therefore, water quality data for these units was not collected for this study. Published data on the water quality of these units are available (NMEID, 1980).
The water chemistry of the two surficial water-bearing units which have the potential of being affected by Navajo's operation is summarized in Appendix B. The water quality in the Pecos River Valley alluvial sand/silt aquifer is well defined near the evaporation ponds and is consistent with surface water quality data from the Pecos River (Figure 4-10). Comparison of ground water quality with water quality in the evaporation ponds reveals that, in terms of the major cations/anions and metals, the water quality in the lagoons is better than or equal to ground water quality (Appendix B). Both are unsuitable for use as irrigation, domestic or industrial purposes. Even though some monitor wells have an odor characteristic of hydrocarbons, in all wells sampled except for well #13 neither phenols, toluene nor benzene are present in concentrations above ground water standards.

Four monitoring well points were installed near the evaporation lagoons to further define the background water quality of the aquifer and to determine if any contamination was present downgradient from the impoundments. The results of the analyses are shown in Appendix B. These results are consistent with previous data which demonstrate that the water quality in the area of the evaporation lagoons is very poor and in some areas exceeds 10,000 mg/l TDS.

Directly downgradient from the impoundments several monitor wells exhibit water quality significantly better than 10,000 mg/l TDS. This change may be due to leakage of better quality pond fluid into the aquifer. No listed organic contaminants were detected in samples from the well points. However, alphatic hydrocarbons were detected by NMOCD in upgradient well and by Geoscience in well point #2. The source of these organic compounds is not known but is presumably a background condition.

These water quality data demonstrate that no degradation of ground water has occurred in the area of the evaporation ponds.

Water quality in the perched terrace/regolith water-bearing unit is also well defined (Appendix B). The water quality in this unit is better than the Pecos Valley alluvium. It should be noted that the ground water in this perched water-bearing zone under the refinery is under some artesian pressure. Direct contamination of this ground water is therefore unlikely. The lithologic logs of the monitor wells (Appendix A) indicate that the soil in the aquitards above the unit is locally contaminated from surficial spills. Therefore, the ground water in some wells may in fact be unaffected by spills and other discharges from the wastewater management system. High hydrocarbon or TDS content in samples from these wells could be a result of artesian water in the well bore coming into contact with contaminated soil. Many wells have been installed to identify zones of hydrocarbon contamination and four oil recovery systems have been installed to recover product and therefore, mitigate the hydrocarbon contamination (Figure 4-7).

This shallow, perched-water unit appears to be of limited areal extent, and does not seem to be utilized by any supply wells. It is not connected with any of the other aquifers, and it is very unlikely that any possible hydrocarbon contamination would affect any other ground water.

5.0 PROCESS DESCRIPTION AND WASTEWATER CHARACTERISTICS

5.1 OVERVIEW

A petroleum refinery is a complex combination of interdependent operations engaged in separating crude molecular constituents, molecular cracking, molecular rebuilding, and solvent finishing to produce petroleum derived products. There are a number of distinct processes utilized by the industry for the refining crude petroleum and its fractionation products. An EPA survey of the petroleum refining industry, conducted during 1977, indentified over 150 separate processes being used and indentified many more process combinations that may be employed at any individual refinery.

Each process is itself a series of unit operations which cause chemical and/or physical changes in the feedstock or product. In the commercial synthesis of a single product from a single feedstock there are sections of the process associated with the preparation of the feedstock, the chemical reaction, the separation of reaction products, and the final purification of the desired product.

At the Navajo Refining Company Artesia, New Mexico facility the major refining processes are:

1) Crude Oil Fractionation (with vacuum fractionation)
2) Fluidized Catalytic cracking
3) Alkylation
4) Reforming
5) Desulferization

Associated with these processes are several auxiliary activities which do not directly result in conversion of crude oil to product nor result in complex chemical changes in the product but instead separate impurities from the feedstocks and products, or are required for other aspects of the operation and maintenance of refinery. These auxiliary units are:

1. Boilers
2. Cooling towers
3. Storage tanks
4. Water purification facilities
5. Desalting units
6. Drying and sweetening units

Figure 5-1 shows the location of these process and auxiliary units at the refinery. The North Division of the refinery processes New Mexico intermediate crude whereas the South Division processes sour crude. The Artesia facility can refine a total of about 36,000 barrels of crude per day with the South Division producing about five-sixths of the total. Figure 5-2 is a process diagram which shows the interrelationship between the two divisions and the location of discharge points.

Each process or auxiliary unit operation has different water usages associated with it and the nature and quantity of waste water produced by the units varies according to the process involved. The final aqueous effluent of the Artesia Refinery is a blend of 19 process and auxiliary waste streams (Table 5-1) as well as some additional wastewater produced during general cleanup at the facility. The relative flow volumes from the different units are:

Cooling Towers	60%
Boiler Blowdown	20%
Desalter	8%
Process Units and Water Softener	12%

Based upon four Wier measurements taken over the course of several days, the total effluent discharge is approximately 0.627 cfs or about 405,200 gallons per day.

A brief description of each process and its wastewater characteristics is given below.

TABLE 5-1
PROCESS UNITS AND WASTEWATER TREATMENT/DISPOSAL UNITS

LOCATION	PROCESS UNIT	WASTE STREAM SOURCE NUMBER	DISPOSAL/ TREATMENT SYSTEM
South Division	Cooling Tower	1	To South division API Separator
South Division	Boilers	2	To fire control system water storage ponds overflow directly into conveyance ditch
South Division	Crude Unit Desalter (D-130)	3	To South division API separator
South Division	Crude Unit Overhead Accumulator (D-140)	4	To South division API separator
South Division	Crude Unit Stabilizer (D-202)	5	To South division API separator
South Division	Alkylation Unit Regenerator	6	To alky neutralization then to South division API separator
South Division TCC Unit	Cooling Tower and Vacuum Unit	7	To South division API separator
South Division	Crude Unit Straight Run Gasoline stabilizer (W-58)	8	To South Division API separator
North Division	Crude Unit Desalters (D-1, D-2)	9	To North division oil/water separator

North Division	Cooling Tower	10	To North division oil/water separator
North Division	Crude Unit Overhead Accumulator (D-5)	11	To North division oil/water separ-ator
North Division	Low Pressure Boiler	12	To North division oil/water separator
North Division	Crude Unit Overhead Accumulator (D-4)	13	To North division oil/water separator
North Division	Desulfurizers (D-15)	14	To North division oil/water separator
North Division	Fluidized Cat. Cracker Unit Cooling Tower	15	To North division oil/water separator
North Division	Sour Water Stripper Bottom	16	To desalters, excess to North division oil/water separator
North Division	High pressure Boilers	18	To North division oil/water separator
North Division	FCC overhead acc-umulator Unit (DA-301)	17	To North division oil/water separator

5.2 MAIN PROCESS UNIT DESCRIPTIONS AND WASTEWATER CHARACTERISTICS

5.2.1. Crude Oil Fractionation

Fractionation serves as the basic refining process for the separation of crude petroleum into intermediate fractions of specific boiling-point ranges. Fractionation is a thermal distillation process which, at the south crude unit, yields gas, straight run gasoline, naptha, kerosene, diesel, atmospheric gas oil and reduced crude (Figure 5-2). Reduced crude is transferred to the associated vacuum unit where it is further fractionated into asphalt and vacuum gas oil.

In the North Crude Unit, where New Mexico intermediate crude is refined, the product streams consist of gas, straight run gasoline, naptha, kerosene, diesel and topped crude. Wastewater produced from the crude units contains ammonia, sulfides, chlorides, oil, and phenols. The process description flow sheet (Figure 5-2) shows the location of all wastewater discharges for this and other units. Table 5-1 summarizes the type of effluent produced at each unit and shows the treatment units to which the streams are discharged. Six wastestreams originate in the crude units: the bleedstream from the overhead accumulators #4, #5, #8, #11 and #13 and the effluent from the vacuum distillation unit (co-mingled with blowdown from the TCC cooling tower, #7). Like all wastestreams that have contacted crude or product (contact wastewater) and contain oil, these streams are treated in the oil/water separators prior to release into the conveyance ditch and the evaporation ponds. A chemical characterization of wastestreams #4, #5, #8, #11 and #13 is shown in Table 5-2.

5.2.2. Catalytic cracking

Fluidized catalytic cracking process is employed at Navajo. Catalytic cracking involves at least four types of reactions:

1) Thermal decomposition
2) Primary catalytic reactions at the catalyst surface
3) Secondary catalytic reactions between the primary products
4) Removal of products which may be polymerized from further reactions by adsorption onto the surface of a fluidized bed of catalyst as coke.

TABLE 5-2
CHEMICAL ANALYSES OF SELECTED WASTE
STREAMS AT NAVAJO REFINERY (AFTER BRANVOLD, 1984)
(VALUES IN MG/L EXCEPT WHERE NOTED)

WQCC 3-103 STANDARDS	CRUDE UNIT PROCESS (#4, #11, #13)	CAT. CRACKER PROCESS BEFORE SOUR WATER STRIPPER	SOUR WATER STRIPPER EFFLUENT (#17)	ALKY. NEUTRALIZING SEWER (#6)	ND & SD DESALTERS (#3, #9)
As					
Ba					
Cd					
Cr	<0.1	<0.1	<0.1	7.8	
CN	<0.1	<0.1	<0.1	<0.1	<1.0
F	1.3	0.5	0.4	10.8	
Pb					
Hg					
NO_3					
Se					
Ag					
U					
Cl					
Cu					
Fe	<0.1	3.9	17.0	7.8	
Mn					
SO_4					
TDS	805	2160	560	2872	2524
Zn	<0.1	<0.1	0.12	18.8	
pH	6.3	9.0	9.5	3.6	
Al					
B					
Co					
Mo					
Ni					
Phenols	9.9	710	250	0.26	
TSS					
Cond.					
COD	1202	8379	1702	8870	600
NH_4	78	2320	256	<1	5.0
S	64	180	7.7	1.4	<1.0

Table 5-2 (continued)

BOILERS

WQCC 3-103 PARAMETERS	S.D. BOILER BLOWDOWN (#2)	N.D. HIGH PRESSURE BOILER (#18)	N.D. LOW PRESSURE BOILER (#12)
As	.004	.005	.003
Ba	<.1	<.1	<.1
Cd	<.01	<.01	<.01
Cr	<.05	<.05	<.05
CN			
F	3.1	2.2	1.5
Pb	.18	.14	.05
Hg			
NO_3	.2	.1	.05
Se			
Ag	<.05	<.05	<.05
U	<.05	<.05	<.05
Cl	127	73	44
Cu	<.03	<.03	<.03
Fe	1.9	0.65	0.25
Mn	.07	<.03	<.03
SO	1549	1242	693
TDS	4220	2873	1807
Zn	.06	<.01	<.01
pH	11.6	11.6	11.2
Al	<1.0	<1.0	<1.0
B			
Co	<.01	.02	.01
Mo	<.5	<.5	<.5
Ni	<.05	<.05	<.05
Phenols			
TSS	20	0	0
Cond.	6000	5000	2800
COD	116	0	0
NH_4			
S			

Table 5-2 (continued)

COOLING TOWERS

WQCC 3-103 STANDARDS	N.D. COOLING TOWER BLOWDOWN (#10)	S.D. ALKY COOLING TOWER BLOWDOWN (#1)	S.D. TCC COOLING TOWER BLOWDOWN	N.D. FCC COOLING TOWER BLOWDOWN (#16)
As	.004	<.001	.011	.001
Ba	<.1	<.1	<.1	<.1
Cd	<.01	<.01	<.01	<.01
Cr	.06	1.05	<.05	0.22
CN				
F	1.6	4.4	2.2	1.6
Pb	.05	.05	<.05	.05
Hg				
NO_3	.5	.75	.2	.3
Se				
Ag	<.05	<.05	<.05	<.05
U	<.05	<.05	<.05	<.05
Cl	48	53	44	47
Cu	<.03	<.03	<.03	<.03
Fe	.05	.5	<.05	<.05
Mn	<.03	.07	<.03	<.03
SO	1077	1461	1236	1067
TDS*	1906	2732	1694	1973
Zn	.48	28	<.01	.17
pH	7.6	6.9	7.7	8.0
Al	<1.0	<1.0	1.0	<1.0
B				
Co	<.01	.01	.02	.01
Mo	<.5	<.5	<.5	<.5
Ni	<.05	<.07	<.05	<.05
Phenols				
TSS	13	0	67	0
Cond.	0	0	108	1800
COD	1850			15
NH_4	0			

The catalysts are in the form of powder for the fluidized unit. The catalyst is usually heated and lifted into the reactor area by the incoming oil feed which, in turn, is vaporized upon contact. Vapor from the reactor pass upward through cyclone separators which remove most of the entrained catalyst. These vapors then enter the fractionator, where the desired products are removed and heavier fractions recycled to the reactor.

The major wastewater constituents resulting from catalytic cracking operations are oil, sulfides, phenols, cyanides, and ammonia. These produce an alkaline wastewater with high BOD and COD concentrations. Sulfide and phenol concentrations in the wastewater can be significant.

The wastestreams produced by the FCC unit are #15 and #17. Both #8 wastestreams are contact wastewater and are sent directly to the oil/water separators as shown in Table 5-1. A characterization of the effluent from the catalytic cracking process before and after sour water stripping is displayed in Table 5-2.

5.2.3. Alkylation

Alkylation is the reaction of an isoparaffin (usually isobutane) and an olefin (butylenes) in the presence of hydroflouoric acid as a catalyst at carefully controlled temperatures and pressures to produce a high octane alkylate for use as a gasoline blending component. The reaction products are separated in a catalyst recovery unit, from which the catalyst is recycled.

The wastewater from the alkylation unit is an acidic solution containing some suspended solids, oil, dissolved solids, fluoride and phenols. The waste stream (#6) is discharged to the neutralizing sewer and is treated to raise the pH prior to discharge to the API oil/water separator (see Table 5-1). An analysis of this comingled wastestream is shown in Table 5-2.

5.2.4. Reforming

Reforming converts low octane naphtha, naphthene-rich stocks to high-octane gasoline blending stock, aromatics for petrochemical use, and isobutane. At Navajo the reformers do not produce a waste stream. Feed stocks are usually hydrotreated for the removal of sulfur and nitrogen compounds prior to charging to the reformer (see Section 5.3.6), since the extremely expensive platinum catalysts used in the unit are readily contaminated and ruined by the sulfur and nitrogen compounds. The predominant reaction during reforming is the dehydrogenation of naphthenes. Important secondary reactions are the isomerization, cyclization and cracking of paraffins. All reactions result in high octane products.

5.2.5 Desulfurizers

Desulfurizing is primarily used to remove sulfur compounds, and other impurities from gasoline, kerosene, jet fuels and diesel fuel. The wastewater typically consists of sulfides or phenolic compounds. This waste stream (#14) is routed to oil water separator.

5.3 AUXILIARY PROCESS UNIT DESCRIPTIONS AND WASTEWATER CHARACTERISTICS

5.3.1 Boilers

Steam is consumed throughout the refining process and is generated in boilers at the North and South Divisions. To assure proper operation of the boilers, a certain amount of boiler water must be discharged (blowdown) and treated water added as make-up. Boiler blowdown is used as a water source for the fire protection system (Table 5-1) prior to direct discharge into the conveyance ditch. Analyses of the boiler blowdown wastestreams (#2, #17 and #12) are shown in Table 5-2. A characterization of the fire water pond is also included in Appendix B.

5.3.2 Cooling Towers

Water used for cooling process streams throughout the facility is cooled by cooling towers located in both the North and South Divisions and comprises most of the water usage at the facility. A significant amount of water is lost by evaporation in the cooling towers resulting in an increased concentration of dissolved solids in the cooling water over time. To prevent scaling, corrosion and biological growth in the towers, inhibitors such as chromate are added to the cooling water. Blowdown from cooling towers pass through the oil water separator to permit contact of chromate with the oil in the separator. This precipitates much of the metal due to reduction of the metal. Analyses of cooling tower blowdown (#1, #10 and #15) is displayed in Table 5-2.

5.3.3 Water Purification System

Pure water must be supplied to several of the boiler units as well as some process systems. Backwash from the purification system contains dissolved solids removed from the water supply system. The water purification system is basically a water softener and produces a periodic waste stream enriched in dissolved solids. The waste is never in contact with product and is discharged directly into the conveyance ditch in the South Division and to the Oil Water separator in the North Division.

5.3.4 Desalters

All produced crude contains some formation (connate) water and suspended solids. Because South Eastern New Mexico crude is generally found in marine formations, this water is highly saline. Desalters remove the saline fluid and suspended solids from the crude by passing crude (with some added water) through an electrostatic field which acts to agglomerate the dispersed brine droplets.

Wastewater can contain high dissolved solids, phenols and (depending upon crude type) ammonia and sulfides. This contact waste water is discharged to the oil-water separator. This waste stream is a significant contributer to the total effluent volume. A characterization of desalter effluent (streams #3 and #9) is shown in Table 5-2.

5.3.5 Washdown and Stormwater

A certain amount of wash water is intermittently utilized for general clean-up of the facility. This activity occurs within the concrete lined process areas. In areas where the clean up may result in oil-contaminated water, the areas drain to the oil water separator sewer. At the heat-exchanger bundle cleaning area the concrete pad drains directly into a sump which is constructed similar to an oil water separator thence into the conveyance ditch and thence to the evaporation ponds.

5.3.6 Storage Tanks

Storage of crude and product typically permits some separation of any water or suspended solids entrained in the fluid. These wastes, removed from the tank bottoms, contain emulsified oil, phenols, iron, sulfide and other consituents which depend upon the nature of the material stored in a particular tank. This liquid is removed to the oil water separators by vacuum trucks. The volume of effluent from this unnumbered source is also small.

5.3.7 Produced Water from Oil Recovery System

The oil recovery system pumps water from below the oil-water interface in order to create a gradient toward the skimmer pump in the trench. This water is discharged directly into the conveyance ditch.

6.0 PRESENT WASTE MANAGEMENT SYSTEM

The Navajo Artesia Refinery generates, treats and disposes of liquid and solid wastes. RCRA solid wastes, which include oil-water separator sludges, heat exchanger bundle cleaning sludges, slop oil emulsion solids and, when produced, leaded tank bottoms are disposed of at the RCRA landfarms on the refinery site pursuant to U.S. EPA regulatory provisions. These waste treatment facilities are fully addressed in EPA permitting documents and are not discussed further in this discharge plan. The wastewater management system presently employed by Navajo is composed of four units: the evaporation ponds, the conveyance ditch, and the two oil-water separators. A general description of each unit is provided below.

6.1 OIL/WATER SEPARATORS

All wastewater delivered to the oil-water separators flow by gravity from the discharge points through subsurface pipelines. At the separators the flow velocity is reduced and the density difference between the water and entrained oil permits separation of the two phases. The oil is then skimmed from the water and pumped back to the processing units. Chromate and other metals which are discharged into the separator are removed from solution by the reducing effect of the hydrocarbons. The effluent is discharged to the conveyance ditch. The sludges are removed to the RCRA landfarm.

Periodically, blow sand and suspended solids in the effluent will enter the separator and oil droplets may adhere to the solid. This phenomenon results in a sand/oil particle which may have the same density as water. These oily particles can flow through the unit and into the conveyance ditch. Upsets in the plant can also result in a short-term oily discharge from the separators. Much of the oil and grease discharged into the ditch will settle into the soft, bottom sediments. Over time this oil, grease and sediment has formed a very fine-grained asphaltic "liner" for the ditch.

6.2 Conveyance Ditch

The conveyance ditch originates at the oil-water separators and terminates at the evaporation ponds in Section 1,6 and 12 (T. 17 S., R. 26 E.) approximately three miles east of the refinery. As Figure 2-1 shows, the ditch is sub-parallel to Eagle Creek until it nears the Pecos River, where the ditch then turns south toward the evaporation ponds. The ditch is generally about 3-4 feet wide and less than 1 foot deep. Throughout its course, it is bermed to prevent any influx of stormwater or excess irrigation water.

In the refinery area several wastestreams discharge directly into the ditch. These streams (eg. boiler blowdown) are not contact wastewater and, therefore, need not be routed to the oil/ water separators.

6.3 Evaporation Ponds

Originally, three ponds were built to evaporate the wastewater generated at the refinery. At the present time, the berm between the lower ponds (2 and 3) has been removed resulting in a two-pond system. The ponds cover an area of approximately 85 acres and are generally less than 3 feet deep. The ponds are bermed to prevent any storm water runoff from entering the impoundment.

All of the wastewater discharged by the refinery is disposed of in these ponds. The effluent in these ponds is a very good representation of the overall quality of the discharges from the facility. Upsets in the refinery and minor modifications of the operation could result in a variable quality of discharge. The ponds, however, have a long enough retention time to adequately homogenize the effluent. Analyses of the fluid in the ponds is shown in Appendix B.

7.0 FUTURE WASTEWATER MANAGEMENT

Recent NMEID chemical analyses of sludges from the wastewater conveyance ditch and Evaporation Pond #1 show concentrations of heavy metals which would classify this material as a hazardous waste. Evaporation Pond #1 is now considered a hazardous waste surface impoundment by the NMEID.

Managing the evaporation lagoons as hazardous waste surface impoundments is not economically realistic and Navajo intends to close Pond #1 pursuant to RCRA. After 1988 neither the conveyance ditch nor the evaporation ponds will be employed to manage wastewater discharged directly from the oil/water separators. If the conveyance or other evaporation ponds are utilized, the wastewater managed by these units will be biologically treated and be of significantly better quality than is presently being discharged. Biological treatment of wastewater is also consistent with proposed RCRA regulations (Appendix C).

7.1 WASTEWATER MANAGEMENT OPTIONS FOR WASTEWATERS DISCHARGED TO THE OIL WATER SEPARATORS

All waste streams which are presently discharged to the oil/water separators will be subject to biological treatment prior to discharge to the land surface (eg. evaporation ponds, land application of treated effluent, NPDES discharge to Pecos River). Two options for treatment are presented below. One of these options will be implemented prior to 1988.

7.1.1 OPTION 1: Discharge of Treated Effluent To Artesia POTW

In addition to primary oil seperation provided by the existing oil water separators, an air floatation unit will be employed for additional treatment prior to discharge to the City of Artesia Publicly Owned Treatment Works. The pre-treated effluent will be further treated at the POTW to meet the City of Artesia's NPDES permit restrictions and their NMEID ground water discharge plan requirements.

Pipelines will be used to transfer effluent between generation points and treatment process units in the refinery area as well as between the refinery and the POTW. No ground water monitoring is necessary nor proposed.

7.1.2 OPTION 2: Biological Treatment and Discharge to Pecos River

In the unlikely event that discharge to Artesia's POTW is not possible, Navajo will design and construct a new wastewater management system which include a biological treatment unit for refinery wastes.

Prior to discharge to the biologic treatment unit the refinery waste will receive primary oil/water separation followed by secondary floatation treatment. Options for biological treatment include:

- o aerated lagoons
- o trickling filters
- o oxidation ditch
- o activated sludge
- o rotating biological contactors

Biologic treatment of waste will substantially alter the character of the final refinery effluent.

7.2 BOILER BLOWDOWN WASTEWATER MANAGEMENT

The existing fire water pond presently receives all boiler blowdown from the south division. The naturally-lined pond is located upgradient from the oil recovery trench RW-4. The area downgradient from the Fire Water Pond contains oil-contaminated soil and ground water under Artesian conditions.

If any leakage from the naturally-lined Fire Water ponds does occur:

- o It would generally improve the quality of the soil water
- o It could not affect the Artesian ground water in this area
- o All leakage will be captured by RW-4 recovery well/trench.

Future discharges from the Fire Water Pond will be co-mingled with the biologically-treated effluent and discharged with the treated effluent or discharged directly to the Artesia POTW.

7.3 WATER SOFTENER WASTEWATER MANAGEMENT

Discharges from the water softener will be co-mingled with the biologically-treated effluent discharged to Navajo's wastewater management system or discharged directly to the Artesia POTW.

8.0 MONITORING AND REPORTING

Ground water analyses show that utilization of the evaporation lagoons and conveyance ditch has not resulted in significant degradation of ground water (Appendix C and Section 4.7). Continued use of the impoundments and ditch prior to biological wastewater treatment in 1988, will not affect ground water which is presently being used. Therefore, no ground water monitoring is planned. However, additional monitoring may occur as a result of closure activities for Evaporation Pond #1.

9.0 BASIS FOR DISCHARGE PLAN APPROVAL

- Ground water sampling and analyses performed to date show that ground water quality in the area of the conveyance ditch and evaporation ponds has not been significantly affected by over 20 years of discharges.

- Discharges into the present wastewater management system for the next three years will not result in concentrations in excess of the Standards of Section 3-103 or the presence of any toxic pollutant at any place of withdrawal of water for present or reasonably fuseable future use.

- By 1988 Navajo Refining Company will utilize biological treatment of effluent presently discharged from the oil water separators. This will significantly improve the quality of wastewater.

- In the next few months Navajo, NMOCD, AND NMEID will be working together to develop a schedule for implementation of biological treatment of wastewater.

2DISCHS7.RPT

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APPENDICES FOR NAVAJO REFINING COMPANY ARTESIA, NEW MEXICO

July 31, 1985

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APPENDIX A
WELL LOGS

PREVIOUSLY SUBMITTED

APPENDIX B
WATER QUALITY ANALYSES

WATER QUALITY OF MONITOR WELLS
NEAR EVAPORATION PONDS

ASSAIGAI

ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

CUSTOMER Navajo Refining Co(ny
ADDRESS Box 526
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

Kinney

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. #20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80 10/81
Navajo Well #1	Acidity		179	
	Alkalinity, "P" (As $CaCO_3$)	<	1	
	Barium		0.1	
	Biochemical Oxygen Demand		44	
	Cadmium		0.05	
	Chemical Oxygen Demand		145	
	Chloride		8313	5800
	Chromium		0.002	
	Chromium 6+	<	0.01	
	Copper		0.001	
	Fluoride		0.9	0.8
	Hardness (as $CaCO_3$)		5760	
	Iron	<	0.05	
	Lead		0.006	
	Magnesium		850	
	Nickel		0.02	
	pH Units		7.8	
	Phenols		0.015	
	Alkalinity , "M"		700	
	Solids, Total Dissolved		19700	15800
	Sulfate		4920	
	Sulfide		0.21	
	Zinc	<	0.1	

Cl/80

169

Sample Analysis by: B.P.
Date and Time of Analysis: BOD_5 - 4/24/81 @ 1600 hrs.
pH: 4/30/81 @ 1400 hrs.
Method of Analysis: BOD_5 - 5 day incubation
pH: electrode

cep

4/30/81 APPROVED BY Elmer D. Martinez, Director of Quality

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502
Telephone 505/982-9841

CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
[illegible]OICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	mg/liter	11/21/80	4/3/7[illegible]
Navajo Well # 3	Acidity	32		
	Alkalinity, "P" (as $CaCO_3$)	< 1.0		
	Barium	< 0.1		
	Biochemical Oxygen Demand	40		
	Cadmium	0.009		
	Chemical Oxygen Demand	73		
	Chloride	2652	2200	1180
	Chromium	< 0.001		
	Chromium 6+	< 0.01		
	Copper	< 0.001		
	Fluoride	1.6	5.0	3.21
98	Hardness (as $CaCO_3$)	2760		
	Iron	0.01		
	Lead	< 0.001		
	Magnesium	250		
	Nickel	< 0.01		
	pH Units	7.4		
	Phenols	< 0.001		
	Alkalinity, "M"	356		
	Solids, Total Dissolved	7730	7640	6777
	Sulfate	2720		
	Sulfide	0.10		
	Zinc	< 0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

CEC

APPROVED BY [signature]

Elmer D. Martinez, Director of Quality Assurance

4/30/81

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P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible] y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
[IN]VOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/8/77
Navajo Well # 5	Acidity		36		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium		0.1		
	Biochemical Oxygen Demand		24		
	Cadmium		0.05		
	Chemical Oxygen Demand		176		
	Chloride		7089	8600	4125
	Chromium		0.002		
165	Chromium 6+	<	0.01		
	Copper		0.001		
	Fluoride		0.44	0.96	0.43
	Hardness (as $CaCO_3$)		4660		
	Iron		0.04		
	Lead		0.007		
	Magnesium		650		
	Nickel	<	0.01		
	pH Units		7.7		
	Phenols	<	0.001		
	Alkalinity, "M"		506		
	Solids, Total Dissolved		16,800	21,100	7367
	Sulfate		4290		
	Sulfide		0.13		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance
4/30/81

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CUSTOMER Navajo Refining Co ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
VOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/79
Navajo Well # 7	Acidity		36		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium	<	0.1		
	Biochemical Oxygen Demand		38		
	Cadmium		0.04		
	Chemical Oxygen Demand		136		
	Chloride		3570	3400	8072
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.004		
	Fluoride		0.3	0.92	0.46
.64	Hardness (as $CaCO_3$)		3160		
	Iron		0.05		
	Lead		0.001		
	Magnesium		370		
	Nickel	<	0.01		
	pH Units		8.0		
	Phenols	<	0.001		
	Alkalinity, "M"		596		
	Solids, Total Dissolved		14,200	21,500	28,05
	Sulfate		5600		
	Sulfide		0.05		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance
4/30/81 PAGE 8 OF 13 PAGE

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REPORT OF ANALYSIS

CUSTOMER Navajo Refining Co(ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter	11/21/80
Navajo Well # 9	Acidity		36	
	Alkalinity, "P" (as $CaCO_3$)	<	1.0	
	Barium	<	0.1	
	Biochemical Oxygen Demand		36	
	Cadmium		0.01	
	Chemical Oxygen Demand		88	
	Chloride		2703	2200
	Chromium		0.002	
	Chromium 6+	<	0.01	
	Copper		0.006	
	Fluoride		0.7	1.8
.65	Hardness (as $CaCO_3$)		3120	
	Iron		0.01	
	Lead		0.001	
	Magnesium		370	
	Nickel	<	0.01	
	pH Units		7.7	
	Phenols	<	0.001	
	Alkalinity, "M"		322	
	Solids, Total Dissolved		10,400	9820
	Sulfate		4160	
	Sulfide		0.03	
	Zinc	<	0.1	

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 9 OF 13 PAGE

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CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/3/?
Navajo Well # 12	Acidity		55		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium	<	0.1		
	Biochemical Oxygen Demand		38		
	Cadmium		0.07		
	Chemical Oxygen Demand		256		
	Chloride		8058	6700	7300
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.002		
	Fluoride		0.9	2.5	1.49
.10	Hardness (as $CaCO_3$)		8920		
	Iron		0.04		
	Lead		0.007		
	Magnesium		1330		
	Nickel		0.02		
	pH Units		7.6		
	Phenols		*< 0.001		
	Alkalinity, "M"		545		
	Solids, Total Dissolved		28,900	29,000	2984
	Sulfate		11,500		
	Sulfide		0.05		
	Zinc	<	0.1		

* Data will follow on 5/6/81.

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance
4/30/81

Controls for Environmental Pollution, Inc.
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REPORT OF ANALYSIS

CUSTOMER Navajo Refining Co[ ]ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
[IN]VOICE NO. 104223

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/?/7?
Navajo Well # 13	Acidity		11		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium		0.1		
	Biochemical Oxygen Demand		22		
	Cadmium		0.002		
	Chemical Oxygen Demand		48		
	Chloride		357	390	123
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.001		
	Fluoride		1.2	3.5	1.47
	Hardness (as $CaCO_3$)		1570		
.20	Iron		0.02		
	Lead		0.003		
	Magnesium		79		
	Nickel	<	0.01		
	pH Units		7.4		
	Phenols	<	0.001		
	Alkalinity, "M"		146		
	Solids, Total Dissolved		3200	3060	2531
	Sulfate		1810		
	Sulfide		0.04		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance
4/30/81 PAGE 11 OF 13 PAGE

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502
Telephone 505/982-9841

CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Well # 16	Acidity		13
	Alkalinity, "P" (as $CaCO_3$)	<	1.0
	Barium	<	0.1
	Biochemical Oxygen Demand		44
	Cadmium		0.002
	Chemical Oxygen Demand		152
	Chloride		1173
	Chromium	<	0.001
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		0.44
	Hardness (as $CaCO_3$)		1610
	Iron	<	0.01
	Lead		0.002
	Magnesium		140
	Nickel	<	0.01
	pH Units		7.7
	Phenols		0.016
	Alkalinity, "M"		425
	Solids, Total Dissolved		4,770
	Sulfate		1,890
	Sulfide		0.10
	Zinc		0.1

.62

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 12 OF 13 PAGE

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter
Navajo Well # 17	Acidity		17
	Alkalinity, "P" (as $CaCO_3$)	<	1.0
	Barium		0.1
	Biochemical Oxygen Demand		42
	Cadmium		0.03
	Chemical Oxygen Demand		88
	Chloride		4692
	Chromium		0.002
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		0.3
	Hardness (as $CaCO_3$)		4470
	Iron		0.03
	Lead		0.005
	Magnesium		470
	Nickel		0.01
	pH Units		7.6
	Phenols	<	0.001
	Alkalinity, "M"		198
	Solids, Total Dissolved		11,200
	Sulfate		2,930
	Sulfide		0.03
	Zinc		0.1

16

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Cor[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

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REPORT OF ANALYSIS

~~NAVAJO REFINING CO.~~

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	
Well Water	Acidity		13	10/3/7
	Alkalinity, "P" (as $CaCO_3$)	<	1	
	Barium	<	0.1	
	Biochemical Oxygen Demand		38	
	Cadmium		0.002	
	Chemical Oxygen Demand		88	
	Chloride		1632	1430
	Chromium		0.002	
	Chromium 6+	<	0.01	
	Copper		0.004	
	Fluoride		0.25	0.32
	Hardness (as $CaCO_3$)		2400	
	Iron		0.06	
	Lead		0.005	
	Magnesium		310	
	Nickel	<	0.01	
	pH Units		7.8	
	Phenols		0.022	
	Alkalinity, "M"		205	
	Solids, Total Dissolved		6860	6162
	Sulfate		2830	
	Sulfide		0.03	
	Zinc		0.2	

0.58

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

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Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 1 OF 13 PAGE

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Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co. .any
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81

CUSTOMER ORDER NUMBER P.O. #20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	mg/liter
Navajo Well #12	Phenols	< 0.001

4/30/81

APPROVED BY Elmer D. Martinez, Director of Quality Assurance

PAGE 1 OF 1 PAGE

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502
Telephone 505/982-9841

WATER QUALITY OF MONITOR WELLS
IN REFINERY AREA

ASSAIGAI
ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE — SAMPLE ID/ANALYTICAL RESULTS

ANALYTE	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l

ANALYTE	103184 1520 Well 47	103184 1550 Fire Pond
Benzene	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l

ANALYTE	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l

ANALYTE	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

ASSAIGAI

ANALYTICAL LABORATORIES, INC.

TO: Geo Science
Attn: Randy Hicks
500 Copper N.W.
Albuquerque, NM 87105

DATE: 3 December 1984
1111

ANALYTE	SAMPLE IDENTIFICATION/ANALYTICAL RESULTS		
	Fire Pond 10/31/83 1550	Well 47 10/31/84 1520	Well 28 11/1/84 1330
Phenols	20.0 ug/l	33.0 ug/l	20.0 ug/l
Cl	134.0 mg/l	122.0 mg/l	101.0 mg/l
SO	1800.0 mg/l	1400.0 mg/l	2150.0 mg/l
TDS	3664.0 mg/l	2728.0 mg/l	5192.0 mg/l
TSS	96.0 mg/l	13588.0 mg/l	720.0 mg/l
NO	2.18 mg/l	1.79 mg/l	1.63 mg/l
NH	1.0 mg/l	0.3 mg/l	0.3 mg/l
Cr	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l

	Well 45 10/31/84 1432	Well 10/31/84 1240	NOMINAL DETECTION LIMIT
Phenols	16.0 ug/l	13.0 ug/l	0.01 ug/l
Cl	495.0 mg/l	446.0 mg/l	1.0 mg/l
SO	1650.0 mg/l	2100.0 mg/l	1.0 mg/l
TDS	3836.0 mg/l	3988.0 mg/l	1.0 mg/l
TSS	2004.0 mg/l	4084.0 mg/l	1.0 mg/l
NO	0.10 mg/l	0.80 mg/l	0.1 mg/l
NH	11.6 mg/l	1.0 mg/l	0.1 mg/l
Cr	<0.01 mg/l	<0.01 mg/l	0.01 mg/l
CN	<0.01 mg/l	<0.01 mg/l	0.01 mg/l

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y., 1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

→7300 Jefferson N.E. → Albuquerque, New Mexico 87109

		Upgradient Well 35	Downgradient Wells 36	37	38
pH		7.28	7.27	7.57	7.37
Spec Cond		3942	9462	9462	7899
TOC	(*)				
TOX Ug/1		318	125	223	170
Chloride	(*)				
Iron		4.6	0.89	0.14	0.73
Manganese		1.34	1.34	1.26	0.789
Phenols		0.001	0.001	0.001	0.001
Sodium	(*)				
Sulfate	(*)				
Arsenic		0.07	0.03	0.02	0.02
Barium		0.1	0.1	0.1	0.1
Cadmium		0.001	0.001	0.001	0.001
Chromium		0.003	0.002	0.001	0.001
Fluoride		1.45	1.34	2.05	1.60
Lead		0.001	0.001	0.001	0.001
Mercury		0.0004	0.0004	0.0004	0.0004
Nitrate		0.1	0.1	0.1	0.1
Selenium		0.01	0.01	0.01	0.01
Silver		0.01	0.01	0.01	0.01
Pest & Herb		-	-	-	-
Radio	(**)	-	-	-	-
Coliform		1	1	2700	1

* Results pending, re-analysis by laboratory.
** Radioactivity activity results were omitted due to high TDS.

Table 5. Chemical data from TEL Weathering area monitoring wells taken 12-1-82.

Geraghty & Miller, Inc.

		Upgradient Well 31	Downgradient Wells 32	33	34
pH		7.31	7.41	7.41	7.30
Spec Cond.		~~25544.5~~ 2489	2693	3590	2563
TOC mg/l	(*)				
TOX ug/l		41.5	102.3	64.5	26
Chloride	(*)				
Iron		0.06	0.01	0.01	1.81
Manganese		1.08	0.311	0.521	0.567
Phenols		0.001	0.001	0.001	0.001
Sodiu		100	35.4	44.4	88.5
Sulfate	(*)				
Arsenic		0.01	0.01	0.01	0.01
Barium		0.1	0.1	0.1	0.1
Cadmium		0.001	0.001	0.001	0.001
Chromium		0.001	0.001	0.001	0.004
Fluoride		1.15	1.28	2.70	1.28
Lead		0.002	0.001	0.001	0.005
Mercury		0.0004	0.0004	0.0004	0.0004
Nitrate		0.1	0.1	0.1	0.1
Selenium		0.01	0.01	0.01	0.01
Silver		0.01	0.01	0.01	0.01
Pest & Herb		ND	ND	ND	ND
Radio	(**)	-	-	-	-
Coliform	(*)				

* Results pending, re-analysis by laboratory.
** Radioactivity results were omitted due to high TDS.

Table 4. Chemical data from the Colony Landfarm monitoring wells taken 12-2-82.

QUALITY OF WATER IN EVAPORATION PONDS

ASSAIGAI

ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040
Page 2 of 2

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS	
	Pond #1 floating film	NOMINAL DETECTION LIMIT
NO_3 as N		0.01 mg/l
NH_4		0.1 mg/l
CN		0.01 mg/l
Benzene	0.617 mg/l	0.005 mg/l
Toluene	0.467 mg/l	0.005 mg/l
Xylenes	0.463 mg/l	0.005 mg/l
Ethylbenzene	0.201 mg/l	0.005 mg/l

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y. ,1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

CUSTOMER Navajo Refining Com y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
OICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter
Navajo East Pond	Acidity		10
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		72
	Cadmium		0.002
	Chemical Oxygen Demand		225
	Chloride		1632
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper		0.002
	Fluoride		5.8
	Hardness (as $CaCO_3$)		1160
	Iron		0.1
	Lead	<	0.001
	Magnesium		110
	Nickel	<	0.01
	pH Units		7.2
	Phenols	<	0.001
	Alkalinity, "M"		214
	Solids, Total Dissolved		4920
	Sulfate		1520
	Sulfide		0.36
	Zinc	<	0.1

10¢

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 2 OF 13 PAGE

CEC

Controls for Environmental Pollution, Inc.

P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Com y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Middle Pond	Acidity		29
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		116
	Cadmium		0.002
	Chemical Oxygen Demand		363
	Chloride		1468
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		7.4
	Hardness (as $CaCO_3$)		1060
	Iron		0.06
	Lead	<	0.001
	Magnesium		96
	Nickel	<	0.01
	pH Units		7.4
	Phenols		0.027
	Alkalinity, "M"		349
	Solids, Total Dissolved		4020
	Sulfate		1050
	Sulfide		13.4
	Zinc	<	0.1

1 40

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible]ay
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter
Navajo West Pond	Acidity		13
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium		0.2
	Biochemical Oxygen Demand		116
	Cadmium		0.003
	Chemical Oxygen Demand		102
	Chloride		918
	Chromium		0.04
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		6.6
	Hardness (as $CaCO_3$)		760
	Iron		0.06
	Lead		0.002
	Magnesium		60
	Nickel		0.01
	pH Units		7.7
	Phenols		0.04
	Alkalinity, "M"		173
	Solids, Total Dissolved		2930
	Sulfate		885
	Sulfide		25.1
	Zinc	<	0.1

10d

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 4 OF 13 PAGE

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CHEMICAL ANALYSES OF GROUND WATER AND SURFACE WATER
NEAR THE EVAPORATION LAGOONS
SAMPLES TAKEN 4/85

ASSAIGAI ANALYTICAL LABORATORIES

TO: Geo Science
Attn: Randy Hicks
500 Copper N.W. Suite 325
Albuquerque, NM 87102

DATE: 2 May 1985
0441 REVISED

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	Navajo Pt 2 #3 on MAP 854110701	Navajo 49 854110721	Pecos River 854100910
EC	14000.0 umhos/cm	8300.0 umhos/cm	9000.0 umhos/cm
TDS	12564.0 mg/l	7620.0 mg/l	7314.0 mg/l
Benzene	<0.001 mg/l	<0.001 mg/l	<0.001 mg/l
	Navajo Pt 4 #2 on MAP 8504111037	Navajo Pecos River 854111120	Navajo Pecos River 854111135
EC	4800.0 umhos/cm	10000.0 umhos/cm	10000.0 umhos/cm
TDS	3852.0 mg/l	8220.0 mg/l	8782.0 mg/l
Benzene	<0.001 mg/l	<0.001 mg/l	<0.001 mg/l

NOMINAL DETECTION LIMITS:

EC	0.1 umhos/cm
TDS	1 mg/l
Benzene	0.001 mg/l

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y., 1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

7300 Jefferson, N.E. • Albuquerque, New Mexico 87109 • (505) 345-8964

ASSAIGAI ANALYTICAL LABORATORIES

TO: GeoScience
Attn: Randy Hicks
500 Copper N.W. Suite 325
Albuquerque, NM 87102

DATE: 23 July 1985
0441

Sample ID	Analysis of Chromatographs
Navajo Pt 2 854110701	No benzene or other hydrocarbons present
Navajo 9 854110721	No benzene or other hydrocarbons present
854100910	No benzene or other hydrocarbons present
Navajo Pt 4 8504111037	No benzene, toluene or ethyl benzene present; Xylenes masked by presence of apliphatic hydrocarbons
Navajo Pecos River 854111120	No benzene or other hydrocarbons present
Navajo Pecos River 854111135	No benzene or other hydrocarbons present

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

7300 Jefferson, N.E. • Albuquerque, New Mexico 87109 • (505) 345-8964

Geoscience Consultants, Ltd.
500 Copper Avenue NW
Suite 220
Albuquerque, New Mexico 87102

CLIENT
LAB
DATE RECEIVED
DATE ANALYZED

WATER QUALITY ANALYSIS

Sample Location Pt #2 by Pecos → Pt 3 ON MAP
Date 4/11/85 Time 0705 Collected By [signature]

SAMPLING CONDITIONS

Samp. Type Well Water
Color Clear
Odor/Taste None/Saline
Water Level 8'2¼" BCT
Datum Casing Top

pH
Cond
Temp
Flow Rate
Elevation

Remarks on sampling and preservation Bailed 2 VOA's, too small for reg. bailer

WATER CHEMISTRY

EC 140,000 μm/cm

X 1 liter plastic cool to 4° C
[] Ca ____ mg/l [] HCO_3 ____ mg/l
[] Mg ____ mg/l [] CO_3 ____ mg/l
[] K ____ mg/l [] Cl ____ mg/l
[] Na ____ mg/l [] F ____ mg/l
[] Si ____ mg/l [] SO_4 ____ mg/l
[X] TDS 13,594 mg/l [] TSS ____ mg/l

____ 500 ml plastic HNO_3 to pH 2
[] As ____ mg/l [] Ag ____ mg/l
[] Ba ____ mg/l [] Se ____ mg/l
[] Cd ____ mg/l [] Fe ____ mg/l
[] Cr ____ mg/l [] Mn ____ mg/l
[] Pb ____ mg/l [] Hg ____ mg/l

____ 500 ml plastic H_2SO_4 to pH 2
[] NO_3 ____ mg/l [] TOC ____ mg/l
[] NH_4 ____ mg/l [] TKN ____ mg/l

2 VOA bottles
[X] Benz ND mg/l [] Tol ____ mg/l
[] Xyl ____ mg/l [] SCAN

[] UREA FORMALDEHYDE ____ mg/l

____ 250 ml glass TOX ____ mg/l
(use 6.25 mg N_aSO_4 if free Cl is present)

250 ml glass H_3PO_4 CuSO4
[] Phenol ____ mg/l

[] Gr Al ____ mg/l [] Gr Bet ____ mg/l

Remarks on Analyses: ____

CHAIN OF CUSTODY

Shipped or delivered to lab by [signature]
Date ____ Time ____

I hereby certify that to the best of my knowledge water samples (amt/size ____) were obtained to accordance with ____'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature [signature] RECEIVING LABORATORY ASSAIGAI
Address
Attn:
____ All Samples received intact.
____ List samples missing or damaged
Date Received 4-15-85 Time 10:10 Am
Accepted by

Geoscience Consultants, Ltd.
500 Copper Avenue NW
Suite 220
Albuquerque, New Mexico 87102

CLIENT ______
LAB ______
DATE RECEIVED ______
DATE ANALYZED ______

pt 2 on MAP

WATER QUALITY ANALYSIS

Sample Location Pt #4, ~1000' SE of Ponds
Date 4/11/85 Time 1037 Collected By J. Hunter

SAMPLING CONDITIONS

Samp. Type	Well water	pH	
Color	Turbid	Cond	6600
Odor/Taste	Faint HC	Temp	15° C
Water Level	6' 7 1/2"	Flow Rate	
Datum	Pipe top	Elevation	

Remarks on sampling and preservation ______

WATER CHEMISTRY

EC ~~CA~~ 48,000

X 1 liter plastic cool to 4° C

[] ~~Ca~~ ___ mg/l	[] HCO_3 ___ mg/l	[] Mg ___ mg/l	[] CO_3 ___ mg/l
[] K ___ mg/l	[] Cl ___ mg/l	[] Na ___ mg/l	[] F ___ mg/l
[] Si ___ mg/l	[] SO_4 ___ mg/l	[X] TDS 4122 mg/l	[] TSS ___ mg/l

___ 500 ml plastic HNO_3 to pH 2

[] As ___ mg/l	[] Ag ___ mg/l
[] Ba ___ mg/l	[] Se ___ mg/l
[] Cd ___ mg/l	[] Fe ___ mg/l
[] Cr ___ mg/l	[] Mn ___ mg/l
[] Pb ___ mg/l	[] Hg ___ mg/l

___ 500 ml plastic H_2SO_4 to pH 2

[] NO_3 ___ mg/l	[] TOC ___ mg/l
[] NH_4 ___ mg/l	[] TKN ___ mg/l

2 VOA bottles

[X] Benz ND mg/l	[] Tol ___ mg/l
[] Xyl ___ mg/l	[] SCAN

☐ UREA FORMALDEHYDE ___ mg/l

___ 250 ml glass H_3PO_4 $CuSO_4$
[] Phenol ___ mg/l

___ 250 ml glass TOX ___ mg/l
(use 6.25 mg N_aSO_4 if free Cl is present)

[] Gr Al ___ mg/l [] Gr Bet ___ mg/l

Remarks on Analyses: ______

CHAIN OF CUSTODY

Shipped or delivered to lab by J. Hunter
Date ______ Time ______

I hereby certify that to the best of my knowledge water samples (amt/size ______) were obtained to accordance with ______'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature [signature] RECEIVING LABORATORY ASSAIGAI
Address ______
Attn: ______
______ All Samples received intact.
______ List samples missing or damaged
Date Received 4-15-85 Time 10:10 AM

Geoscience Consultants, Ltd.
500 Copper Avenue N.W.
Suite 220
Albuquerque, New Mexico 87102

CLIENT
LAB
DATE RECEIVED
DATE ANALYZED

WATER QUALITY ANALYSIS

Sample Location NAVAJO # 49
Date 4/11/85 Time 0721 Collected By J Hunter

SAMPLING CONDITIONS

Samp. Type Well Water
Color
Odor/Taste
Water Level 11' 10"
Datum Guard Pipe Top

pH 7.2
Cond 8300
Temp 15°C
Flow Rate
Elevation

Remarks on sampling and preservation Bailed w/ cleaned PVC bailer

WATER CHEMISTRY

EC 83,000

✓ 1 liter plastic cool to 4° C

[] Ca ____ mg/l [] HCO_3 ____ mg/l
[] Mg ____ mg/l [] CO_3 ____ mg/l
[] K ____ mg/l [] Cl ____ mg/l
[] Na ____ mg/l [] F ____ mg/l
[] Si ____ mg/l [] SO_4 ____ mg/l
[X] TDS 7,620 mg/l [] TSS ____ mg/l

____ 500 ml plastic HNO_3 to pH 2

[] As ____ mg/l [] Ag ____ mg/l
[] Ba ____ mg/l [] Se ____ mg/l
[] Cd ____ mg/l [] Fe ____ mg/l
[] Cr ____ mg/l [] Mn ____ mg/l
[] Pb ____ mg/l [] Hg ____ mg/l

____ 500 ml plastic H_2SO_4 to pH 2

[] NO_3 ____ mg/l [] TOC ____ mg/l
[] NH_4 ____ mg/l [] TKN ____ mg/l

2 VOA bottles

[X] Benz ND mg/l [] Tol ____ mg/l
[] Xyl ____ mg/l [] SCAN

☐ UREA FORMALDEHYDE ____ mg/l

____ 250 ml glass TOX ____ mg/l
(use 6.25 mg N_aSO_4 if free Cl is present)

250 ml glass H_3PO_4 $CuSO_4$
[] Phenol ____ mg/l

[] Gr Al ____ mg/l [] Gr Bet ____ mg/l

Remarks on Analyses:

CHAIN OF CUSTODY

Shipped or delivered to lab by J Hunter
Date ____ Time ____

I hereby certify that to the best of my knowledge water samples (amt/size ____) were obtained to accordance with ____'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature [signature]
Address
Attn:

RECEIVING LABORATORY ASSAGAI

✓ All Samples received intact.
____ List samples missing or damaged

Date Received 4-15-85 Time 10:00 AM
Accepted by [signature]

Geoscience Consultants, Ltd.

500 Copper Avenue N.W.
Suite 220
Albuquerque, New Mexico 87102

CLIENT ______
LAB ______
DATE RECEIVED ______
DATE ANALYZED ______

WATER QUALITY ANALYSIS

Sample Location *Pecos River, N of Ponds*
Date *4/11/85* Time *1135* Collected By *C Hunter*

SAMPLING CONDITIONS

Samp. Type	*River Water*	pH	
Color	*Turbid*	Cond	
Odor/Taste		Temp	
Water Level		Flow Rate	
Datum		Elevation	

Remarks on sampling and preservation ______

WATER CHEMISTRY

EC 100,000

X 1 liter plastic cool to 4° C

[] Ca ___ mg/l	[] HCO_3 ___ mg/l		
[] Mg ___ mg/l	[] CO_3 ___ mg/l		
[] K ___ mg/l	[] Cl ___ mg/l		
[] Na ___ mg/l	[] F ___ mg/l		
[] Si ___ mg/l	[] SO_4 ___ mg/l		
[X] TDS *8782* mg/l	[] TSS ___ mg/l		

___ 500 ml plastic HNO_3 to pH 2

[] As ___ mg/l	[] Ag ___ mg/l
[] Ba ___ mg/l	[] Se ___ mg/l
[] Cd ___ mg/l	[] Fe ___ mg/l
[] Cr ___ mg/l	[] Mn ___ mg/l
[] Pb ___ mg/l	[] Hg ___ mg/l

___ 500 ml plastic H_2SO_4 to pH 2

[] NO_3 ___ mg/l	[] TOC ___ mg/l
[] NH_4 ___ mg/l	[] TKN ___ mg/l

2 VOA bottles

[X] Benz *ND* mg/l	[] Tol ___ mg/l
[] Xyl ___ mg/l	[] SCAN

☐ UREA FORMALDEHYDE ___ mg/l

___ 250 ml glass TOX ___ mg/l
(use 6.25 mg N_aSO_4 if free Cl is present)

250 ml glass H_3PO_4 $CuSO_4$
[] Phenol ___ mg/l

[] Gr Al ___ mg/l [] Gr Bet ___ mg/l

Remarks on Analyses: ______

CHAIN OF CUSTODY

Shipped or delivered to lab by *C Hunter*
Date ______ Time ______

I hereby certify that to the best of my knowledge water samples (amt/size ______) were obtained to accordance with ______'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature *[signature]* RECEIVING LABORATORY *Assaigai*
Address ______
Attn: ______

✓ All Samples received intact.
______ List samples missing or damaged
Date Received *4-15-85* Time *10:10 Am*
Accepted by

Geoscience Consultants, Ltd.
500 Copper Avenue N
Suite 220
Albuquerque, New Mexico 87102

CLIENT ______
LAB ______
DATE RECEIVED ______
DATE ANALYZED ______

WATER QUALITY ANALYSIS

Sample Location Pecos River @ Pipline Crossing
Date 4/10/85 Time 0910 Collected By J Hunter

SAMPLING CONDITIONS

Samp. Type River water
Color Slightly Turbid
Odor/Taste ______
Water Level ______
Datum ______
pH ______
Cond ______
Temp ______
Flow Rate Low
Elevation ______

Remarks on sampling and preservation Collected sample from Pecos River, ~50' downstream from pipeline

WATER CHEMISTRY

X 1 liter plastic cool to 4° C EC, ~~TDS~~ 90,000

[] Ca ___ mg/l [] HCO3 ___ mg/l
[] Mg ___ mg/l [] CO3 ___ mg/l
[] K ___ mg/l [] Cl ___ mg/l
[] Na ___ mg/l [] F ___ mg/l
[] Si ___ mg/l [] SO4 ___ mg/l
[X] TDS 7314 mg/l [] TSS ___ mg/l

___ 500 ml plastic HNO3 to pH 2
[] As ___ mg/l [] Ag ___ mg/l
[] Ba ___ mg/l [] Se ___ mg/l
[] Cd ___ mg/l [] Fe ___ mg/l
[] Cr ___ mg/l [] Mn ___ mg/l
[] Pb ___ mg/l [] Hg ___ mg/l

___ 500 ml plastic H_2SO_4 to pH 2
[] NO_3 ___ mg/l [] TOC ___ mg/l
[] NH_4 ___ mg/l [] TKN ___ mg/l

2 VOA bottles
[X] Benz ND mg/l [] Tol ___ mg/l
[] Xyl ___ mg/l [] SCAN

[] UREA FORMALDEHYDE ___ mg/l

250 ~~ml~~ glass TOX ___ mg/l
(use 6.25 mg Na_2SO_4 if free Cl is present)

250 ml glass H_3PO_4 $CuSO_4$
[] Phenol ___ mg/l

[] Gr Al ___ mg/l [] Gr Bet ___ mg/l

Remarks on Analyses: ______

CHAIN OF CUSTODY

Shipped or delivered to lab by J Hunter
Date ______ Time ______

I hereby certify that to the best of my knowledge water samples (amt/size ______) were obtained to accordance with ______'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature [signature]
Address ______
Attn: ______

RECEIVING LABORATORY Assaigai

✓ All Samples received intact.
___ List samples missing or damaged

Date Received 4-15-85 Time 10:00 am

Accepted by ______

Geoscience Consultants, Ltd.
500 Copper Avenue NW
Suite 220
Albuquerque, New Mexico 87102

CLIENT ______
LAB ______
DATE RECEIVED ______
DATE ANALYZED ______

WATER QUALITY ANALYSIS

Sample Location Pecos River, 200' downstream from EAGLE DRAW
Date 4/11/85 Time 1120 Collected By J Hunter

SAMPLING CONDITIONS

Samp. Type	River Water	pH	
Color		Cond	
Odor/Taste		Temp	
Water Level		Flow Rate	
Datum		Elevation	

Remarks on sampling and preservation ______

WATER CHEMISTRY

EC 100,000

X 1 liter plastic cool to 4° C

[] ~~Ca~~ ____ mg/l	[] HCO_3 ____ mg/l		
[] Mg ____ mg/l	[] CO_3 ____ mg/l		
[] K ____ mg/l	[] Cl ____ mg/l		
[] Na ____ mg/l	[] F ____ mg/l		
[] Si ____ mg/l	[] SO_4 ____ mg/l		
[X] TDS 8220 mg/l	[] TSS ____ mg/l		

____ 500 ml plastic HNO_3 to pH 2

[] As ____ mg/l	[] Ag ____ mg/l
[] Ba ____ mg/l	[] Se ____ mg/l
[] Cd ____ mg/l	[] Fe ____ mg/l
[] Cr ____ mg/l	[] Mn ____ mg/l
[] Pb ____ mg/l	[] Hg ____ mg/l

____ 500 ml plastic H_2SO_4 to pH 2

[] NO_3 ____ mg/l	[] TOC ____ mg/l
[] NH_4 ____ mg/l	[] TKN ____ mg/l

2 VOA bottles

[X] Benz ND mg/l	[] Tol ____ mg/l
[] Xyl ____ mg/l	[] SCAN

☐ UREA FORMALDEHYDE ____ mg/l

250 ml glass H_3PO_4 $CuSO_4$
[] Phenol ____ mg/l

____ 250 ml glass TOX ____ mg/l
(use 6.25 mg N_aSO_4 if free Cl is present)

[] Gr Al ____ mg/l [] Gr Bet ____ mg/l

Remarks on Analyses: ______

CHAIN OF CUSTODY

Shipped or delivered to lab by J Hunter
Date ______ Time ______

I hereby certify that to the best of my knowledge water samples (amt/size ______) were obtained to accordance with ______'s (Owner) sampling and analysis plan and are safely containerized and labeled for delivery to the laboratory.

Signature [signature] RECEIVING LABORATORY ASSAIGAI
Address ______
Attn: ______
______ All Samples received intact.
______ List samples missing or damaged
Date Received 4-15-85 Time 10:00 AM
Accepted by ______

APPENDIX C

PROPOSED CHANGES IN RCRA REGULATIONS

Dated: December 26, 1984

Valdas V. Adamkus,

Regional Administrator.

[FR Doc. 85-3330 Filed 2-8-85; 8:45 am]

BILLING CODE 6560-50-M

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40 CFR Part 261

[WH-FRL-2776-3]

Hazardous Waste Management System; Identification and Listing of Hazardous Waste

AGENCY: Environmental Protection Agency.

ACTION: Notice of availability of data and request for comment.

SUMMARY: On November 12, 1980, the Environmental Protection Agency proposed to amend the listings of two of the hazardous wastes generated by the petroleum refining industry which the Agency promulgated in final form in that same issue of the Federal Register. EPA has collected additional information on these wastes and is making these data available for public comment. EPA also is clarifying that any final listing would apply only to wastes from primary wastewater treatment processes, and not to any wastes from secondary wastewater treatment such as sludges from biological oxidation.

DATES: EPA will accept public comment on this notice until March 13, 1985.

ADDRESSES: Comments should be addressed to the Docket Clerk, Office of Solid Waste (WH-562), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460. Communications should identify the regulatory docket "Petroleum Refining—Section 3001." The public docket for this proposed rulemaking is located in Room S-212A, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460, and is available for viewing from 9:00 a.m. to 4:00 p.m., Monday through Friday, except legal holidays.

FOR FURTHER INFORMATION CONTACT: RCRA Hotline, toll-free at (800) 424-9346 or at (202) 382-3000. For technical information contact Robert Scarberry, Office of Solid Waste (WH-562B), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C., 20460, (202) 475-6725.

SUPPLEMENTARY INFORMATION:

I. Background

On May 19, 1980, as part of its final and interim final regulations implementing Section 3001 of RCRA, EPA published (in interim final form) a list of hazardous wastes (Subpart D of 40 CFR Part 261), which included five wastes generated by the petroleum refining industry (§ 261.32, 45 FR 33123). Among the listed petroleum refining industry wastes were "Dissolved air flotation (DAF) float from the petroleum refining industry (K048)" and "API separator sludge from the petroleum refining industry (K051)." These wastes are generated as a result of primary treatment of wastewater from petroleum refineries. These particular listings were promulgated in final form in 45 FR 74884, November 12, 1980.

A rulemaking petition was submitted by Envirex, Inc.[1] which argued that any petroleum refining sludge resulting from primary or secondary oil/solids/water separation would be similar in composition regardless of the equipment or method used in the separation step. After evaluating the rulemaking petition, the Agency proposed that the K048 and K051 listings be amended to read: "Secondary (emulsified) oil/solids/water separator sludge in the petroleum refining industry" and "Primary oil/solids/water separation sludge in the petroleum refining industry", respectively.

II. Availability of Data

Since the close of the comment period for the proposed amendment, the Agency has obtained additional data characterizing sludges from API separators and DAF units as well as sludges from other methods of primary wastewater treatment. The supplemental data obtained consists of metal and organic analyses which were performed on primary treatment sludges from the following sources:

- Storm runoff ponds
- Primary settling ponds
- Flocculation tanks
- Sumps
- Emulsion tanks
- Induced air flotation tanks
- Evaporation ponds
- Equalization ponds
- Clarifiers
- Cleaning chemicals pits
- Ponds with an oil skimmer

The sludges from these sources have levels of total chromium and lead similar to those levels which are characteristic of sludge from API separators and DAF units. In addition, the organic analyses on these primary wastewater treatment sludges, as well as organic analyses on the sludges from API separators and DAF units, indicate the presence of toxic organic constituents including benzene and toluene at maximum concentrations of 4600 and 11,000 ppm, respectively. Benzo(a)pyrene, chrysene, and pyrene also are present in these sludges at maximum concentrations ranging from 600 to 1700 ppm.

Copies of these new data are available for public inspection in the RCRA Docket, Room S212A. Comments are solicited only on the new data. These comments must be received by EPA on or before March 13, 1985 to ensure their consideration.

III. Clarification of Scope of Listing

As described above, the Agency proposed to amend the descriptions of the K048 and K051 listings in response to a rulemaking petition submitted by Envirex, Inc. (See 45 *FR* 74893, November 12, 1980). The petitioner argued that the May 19 listing descriptions were under-inclusive since they were specific to particular types of equipment, namely the DAF and API separator. According to the petitioner, any petroleum refining sludge resulting from primary and secondary oil/solids/water separation will be comparably composed regardless of the type of equipment used in the separation step. The petitioner pointed out that other processes such as induced air flotation, parallel plate flotation separators, and dual media filtration separators, perform the same function as the DAF and form a similar solids residue. Likewise, the API separator is only one of the many equipment types which function as a primary oil/solids/water separator (other processes producing similar sludges include corrugated plate separators, inclined plate separators, storm equalization lagoons, and ballast waterholding tanks).

After reviewing and evaluating the rulemaking petition, the Agency concluded that the listings should be modified to reflect the hazardous character of the wastes themselves, rather than the type of equipment or process generating the waste. The Agency has agreed that the May 19 listing was too narrow in specifying API separator sludge and DAF float, thereby omitting other petroleum wastes with similar compositions generated from processes and equipment other than API separators and DAF units. In the November 12, 1980 notice, the Agency proposed to adjust the scope of the K048 and K051 listings by amending the listing descriptions to those recommended by the petitioner: "Secondary (emulsified) oil/solids/water separator sludge in the petroleum refining industry" and "Primary oil/solids/water separation sludge in the

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[1] Envirex, Inc. is a manufacturer of sewage, water and waste treatment, and water conditioning equipment for many uses, including applications in the petroleum refining industry.

petroleum refining industry," respectively.

Among other things, the comments received on the November 12, 1980 proposed amendment expressed confusion regarding the scope of the K048 listing. In particular, the commenters were uncertain of the Agency's definition of "Secondary (emulsified) oil/solids/water separator sludge". In regard to the K048 listing, the background listing document [2] specifies the latter of two consecutive *primary* wastewater treatment methods as secondary treatment (*e.g.*, API separator followed by DAF). This use of the term secondary treatment is confusing because biological oxidation of wastewaters is commonly referred to as secondary wastewater treatment, as compared to primary wastewater treatment consisting of physical processes such as sedimentation, flocculation, flotation, and filtration. No discussion of sludge from biological treatment of wastewaters (*e.g.*, activated sludge, trickling filters, etc.) is present in either the background listing document or the Envirex petition. Furthermore, neither of these documents includes sludges from physical oil/solids/water separation processes which follow biological treatment of wastewaters in the K048 listing. To clarify the scope of the K048 and K051 listings, therefore, the Agency intends to consolidate the listings to read, "Sludge from primary wastewater treatment in the Petroleum Refining industry" in a final rule action.[3]

List of Subjects in 40 CFR Part 261

Hazardous materials, Waste treatment and disposal, Recycling.

Dated: February 5, 1985.

Jack W. McGraw,

Acting Assistant Administrator.

[FR Doc. 85-3331 Filed 2-8-85; 8:45 am]

BILLING CODE 6560-50-M

[2] The background listing document and the Envirex rulemaking petition are available in the public docket at the address cited above.

[3] The Agency also is concerned, however, with secondary sludges from biological treatment of refinery wastewaters. To this end, we are currently evaluating these wastes as part of the petroleum refining industry studies program to determine whether they also should be listed as hazardous.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

42 CFR Parts 4, 59a, 63 and 64

National Library of Medicine Programs

AGENCY: Public Health Service, HHS.

ACTION: Notice of proposed rulemaking.

SUMMARY: The Public Health Service, HHS, proposes to revise the regulations for the programs of the National Library of Medicine. The proposed revisions would: (1) Permit the Regional Medical Libraries to recover part or all of the costs of providing photocopies of biomedical materials, (2) improve readability of the regulations, (3) update references to statutory authorities and uniform administrative requirements, and (4) revoke Part 63 (Traineeships) which is obsolete.

DATES: Written comments must be received on or before April 12, 1985.

ADDRESS: Comments should be sent to: NIH Regulations Officer, National Institutes of Health, Building 31, Room 3B03, 9000 Rockville Pike, Bethesda, Maryland 20205. All comments received are available to the public at the above address from 9:00 a.m. to 5:00 p.m., Monday through Friday, except on Federal holidays.

FOR FURTHER INFORMATION CONTACT: Lowell D. Peart, at the above address or (301) 496-4606.

SUPPLEMENTARY INFORMATION: On November 21, 1979, the Public Health Service published a notice of intent to develop regulations in the Federal Register (44 FR 66852) covering 42 CFR Parts 4, 59a, 63, and 64. These regulations, which all concern, in whole or part, the National Library of Medicine, were proposed for revision as part of the Department's efforts to simplify and update its regulations.

The regulations would be clarified and condensed by eliminating regulatory provisions that are obsolete or are already set forth in the HHS uniform requirements for the administration of financial assistance in 45 CFR Part 74.

The following substantive changes would be made.

- Section 59a.16(b)(2) of the proposed rules would liberalize the current § 59a.37(b)(2) to permit the Regional Medical Libraries receiving NLM support to charge reasonable fees: (1) For copies to recover expenses and (2) for such other expenses (other than free loan services) as may be appropriate. The present regulations explicitly prohibit Regional Medical Libraries from recovering costs for photocopying. Other than eliminating this prohibition, we are proposing no other new provisions related to cost recovery in these proposed rules. The Department is currently studying the NLM's fee setting policy. However, since NLM fee setting policies are not established through regulations, any recommendations arising from the Department's study will not require a change to these regulations.
- Part 63 would be revoked because NIH no longer has general traineeship authority and the only remaining NLM program is unfunded with no expectation of being funded.
- Part 64 would be revised to eliminate reference to National Institutes of Health Training Grants, as that authority has been superseded by National Research Service Awards, which are covered in 42 CFR Part 66. Also, provisions such as § 64.7 which cover matters now governed by 45 CFR Part 74 would be removed. The reference to review by an advisory council in former § 64.3 has been removed because the programs which require it are no longer in the regulations and section 393 of the Public Health Service Act, which authorizes NLM training grants, does not require it.

The following statements are provided for the information of the public:

1. These regulations revise existing regulations to improve readability, remove obsolete provisions, and permit certain fees to be recovered. The economic impact of this is expected to be minor. For these reasons, the Secretary has determined that this rule is not a "major rule" under Executive Order 12291, and a regulatory impact analysis is not required. Further, these regulations will not have a significant economic impact on a substantial number of small entities, and therefore do not require a regulatory flexibility analysis under the Regulatory Flexibility Act of 1980.

2. Catalog of Federal Domestic Assistance number program affected by this proposed rule is:

13.879 Medical Library Assistance

3. Sections 4.5, and 59a.4, 59a.14, 59a.16, 64.4, and 64.7 of these proposed rules contain information collection requirements. As required by Section 3504(h) of the Paperwork Reduction Act of 1980 [44 U.S.C. 3504(h)], we have submitted a copy of these proposed rules to the Office of Management and Budget for its review of these information collection requirements. Organizations and individuals desiring to submit comments on the information collection requirements should direct them to the agency official designated for this purpose whose name appears in this preamble, and to the Office of Information and Regulatory Affairs, OMB, New Executive Office Building (Room 3208), Washington, D.C. 20503, Attn: Desk Officer for HHS.

APPENDIX D

FEBRUARY 18, 1985 SUBMISSION TO NMOCD

Geoscience
Consultants, Ltd.

February 18, 1985

Mr. Richard Stamets
NMOCD
P.O. Box 2088
Santa Fe, New Mexico 87501

Re: Effluent Flow and Chemical Characteristics of Waste Streams
Regulated by Discharge Plan

Dear Mr. Stamets:

Navajo Refining Company, Inc. and Geoscience Consultants, Ltd. are pleased to submit our report on effluent characteristics. Our previous submission described the process at the Artesia Refinery and presented chemical data on many individual waste streams. Section 1.0-6.0 of the Discharge Plan also presented chemical analyses of the evaporation pond fluids which represent the best composite sample of the effluent streams.

In the initial meeting of September 17, 1984 it was decided that all waste streams which are disposed of in the evaporation ponds would be governed by this Discharge Plan. These streams are:

- Effluent from the oil/water separator
- Effluent from the water softener
- Boiler blow down
- Effluent from the oil recovery system
- Liquid effluent from the heat exchanger bundle cleaning area
- Other liquid effluent which may be periodically discharged into the conveyance ditch

The chemical data on these waste streams were presented in Sections 1.0-6.0 of the Discharge Plan and are presented with this submission. Note that samples from the evaporation ponds were analised for benzene, toluene, xylene and ethylbenzene. Analyses of individual waste streams were included for information only. Regulatory decisions should consider the quality of the final effluent as characterized by analyses of the effluent flowing to the evaporation ponds.

The flow data is shown in the Table. At the present time no data are available for flow rates at the downstream end of the ditch.

500 Copper Avenue N.W. Suite 220, Albuquerque, New Mexico 87102 (505)

If you or your technical staff have any questions about this submission please contact me at our Albuquerque office.

Sincerely,
GEOSCIENCE CONSULTANTS, LTD.

Randall T. Hicks
Vice President

RTH/mg

cc: Mr. Dave Griffin, Navajo
Mr. Joel Carson, Losee, Carson, Dickerson
M. David Boyer, NMOCD (2 copies)

WATER USAGE

	CITY	WELL	TOTAL
June, 1984	23,695 X 10^3 gal	5,400x10^3 gal	29,095,000 gal
July, 1984	19,799	5,015	24,814,000
August, 1984	24,073	5,400	29,473,000
Sept., 1984	20,509	6,170	26,679,000
Oct., 1984	15,936	10,030	25,966,000
Nov., 1984	12,042	17,745	29,787,000
Dec., 1984	12,213	20,445	32,658,000
Jan., 1985	13,887	14,659	28,546,000

EFFLUENT FLOW DATA

DATE	GPD	PH
6-6-84	342,720	12.0
6-7-84	361,440	12.5
6-8-84	361,440	11.0
6-9-84	361,440	13.0
6-11-84	361,440	12.0
6-12-84	Cleaning ditch north of the FCC	13.5
6-13-84	303,384	11.0
6-14-84	342,720	13.0
6-15-84	342,720	13.5
6-18-84	342,720	9.5
6-20-83	361,440	9.0
6-21-84	342,720	9.0
6-22-84	342,720	10.0
6-23-84	381,440	9.5
6-25-84	361,440	8.5
6-26-84	342,720	9.0
6-27-84	419,040	9.5
6-28-84	380,160	10.5
6-29-84	361,440	11.0
6-30-84	380,160	11.5
7-2-84	342,720	12.5
7-3-84	342,720	10.0
7-5-84	342,720	9.5
7-6-84	380,160	9.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
7-8-84	361,440	9.5
7-10-84	361,440	9.0
7-11-84	342,720	10.0
7-12-84	303,840	10.5
7-15-84	342,720	8.5
7-19-84	380,160	7.5
7-20-84	380,160	9.5
7-23-84	380,160	12.5
7-24-84	361,440	11.0
7-25-84	380,160	12.5
7-27-81	380,160	11.0
7-30-84	361,440	9.0
8-2-84	342,720	9.0
8-3-84	380,160	9.0
8-6-84	342,720	9.0
8-7-84	342,270	10.0
8-8-84	361,440	11.0
8-9-84	361,440	9.0
8-14-84	380,160	8.0
8-15-84	380,160	8.5
8-16-84	419,040	8.0
8-17-84	380,160	8.0
8-20-84	380,160	7.5
8-21-84	380,160	7.5
8-22-84	380,160	8.0

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
8-23-84	380,160	10.0
8-24-84	361,440	9.0
8-27-84	361,440	9.5
8-28-84	380,160	8.5
8-29-84	361,440	10.0
8-30-84	380,160	8.0
8-31-84	380,160	7.5
9-5-84	380,160	7.0
9-6-84	380,160	8.0
9-7-84	380,160	8.0
9-10-84	380,160	8.5
9-11-84	361,440	9.5
9-12-84	380,160	11.0
9-13-84	380,160	9.5
9-14-84	361,440	11.0
9-17-84	342,720	11.5
9-18-84	361,440	9.0
9-19-84	380,160	7.0
9-20-84	361,440	9.0
9-21-84	342,720	9.0
9-24-84	342,720	8.5
9-25-84	361,440	8.5
9-26-84	342,720	10.5
9-27-84	342,720	11.0
10-1-84	361,440	10.0
10-2-84	342,720	9.5

EFFLUENF FLOW DATA CONT.

DATE	GPD	PH
10-3-84	361,440	10.5
10-4-84	342,720	11.0
10-5-84	342,720	10.0
10-8-84	361,440	8.0
10-9-84	342,720	9.5
10-11-84	342,720	10.5
10-12-84	342,720	10.0
10-15-84	361,440	11.5
10-16-84	419,040	7.5
10-17-84	398,880	8.5
10-18-84	398,880	7.5
10-19-84	419,040	7.5
10-22-84	398,880	10.5
10-23-84	419,040	8.5
10-24-84	419,040	7.0
10-25-84	398,880	9.0
10-26-84	398,880	11.0
10-29-84	419,040	8.0
10-30-84	398,880	9.5
10-31-84	398,880	9.0
11-1-84	398,880	6.0
11-2-84	342,720	8.0
11-5-84	380,160	5.5
11-6-84	303,384	4.0
11-7-84	303,384	7.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
11-8-84	380,160	8.5
11-9-84	380,160	7.0
11-10-84	342,720	8.0
11-11-84	342,720	9.5
11-12-84	380,160	9.0
11-13-84	342,720	8.5
11-14-84	303,840	8.5
11-20-84	380,160	7.0
11-21-84	380,160	9.0
11-22-84	342,720	10.0
11-23-84	342,720	9.0
11-26-84	380,160	8.5
11-27-84	398,880	10.0
11-28-84	419,040	10.5
11-29-84	419,040	8.0
11-30-84	380,160	10.0
12-3-84	398,880	11.5
12-4-84	398,880	10.5
12-5-84	380,160	13.0
12-6-84	419,040	9.0
12-7-84	398,880	8.0
12-10-84	380,160	6.5
12-11-84	419,040	11.5
12-12-84	398,880	9.0
12-13-84	419,040	9.0

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
12-14-84	398,880	9.5
12-17-84	380,160	6.0
12-18-84	342,720	7.5
12-19-84	419,040	8.0
12-20-84	380,160	11.5
12-21-84	380,160	10.0
12-26-84	342,720	9.0
12-27-84	342,720	11.0
1-2-85	380,160	9.5
1-3-85	361,440	6.0
1-4-85	361,440	8.8
1-7-85	342,720	9.5
1-8-85	303,384	10.5
1-9-85	342,720	10.0
1-10-85	342,720	12.0
1-11-85	303,384	9.0
1-14-85	342,720	10.0
1-15-85	303,384	8.5
1-16-85	380,160	6.5
1-17-85	342,720	7.5
1-18-85	361,440	8.5
1-21-85	361,440	7.0
1-22-85	342,720	7.0
1-23-85	342,720	8.0
1-24-85	419,040	6.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
1-25-85	361,440	7.5
1-28-85	380,160	7.0
1-29-85	380,160	7.0
1-30-85	361,440	6.0
1-31-85	342,720	7.5
2-1-85	361,440	8.5
2-4-85	342,720	7.0
2-5-85	242,720	9.0
2-6-85	361,440	9.5

TABLE 5-2
CHEMICAL ANALYSES OF SELECTED WASTE
STREAMS AT NAVAJO REFINERY (AFTER BRANVOLD, 1984)
(VALUES IN MG/L EXCEPT WHERE NOTED)

WQCC 3-103 STANDARDS	CRUDE UNIT PROCESS (#4, #11, #13)	CAT. CRACKER PROCESS BEFORE SOUR WATER STRIPPER	SOUR WATER STRIPPER EFFLUENT (#17)	ALKY. NEUTRALIZING SEWER (#6)	NO & SO DESALTERS (#3, #9)
As					
Ba					
Cd					
Cr	<0.1	<0.1	<0.1	7.8	
CN	<0.1	<0.1	<0.1	<0.1	<1.0
F	1.3	0.5	0.4	10.8	
Pb					
Hg					
NO_3					
Se					
Ag					
U					
Cl					
Cu					
Fe	<0.1	3.9	17.0	7.8	
Mn					
SO_4					
TDS	805	2160	560	2872	2524
Zn	<0.1	<0.1	0.12	18.8	
pH	6.3	9.0	9.5	3.6	
Al					
B					
Co					
Mo					
Ni					
Phenols	9.9	710	250	0.26	
TSS					
Cond.					
COD	1202	8379	1702	8870	600
NH_4	78	2320	256	<1	5.0
S	64	180	7.7	1.4	<1.0

Table 5-2 (continued)

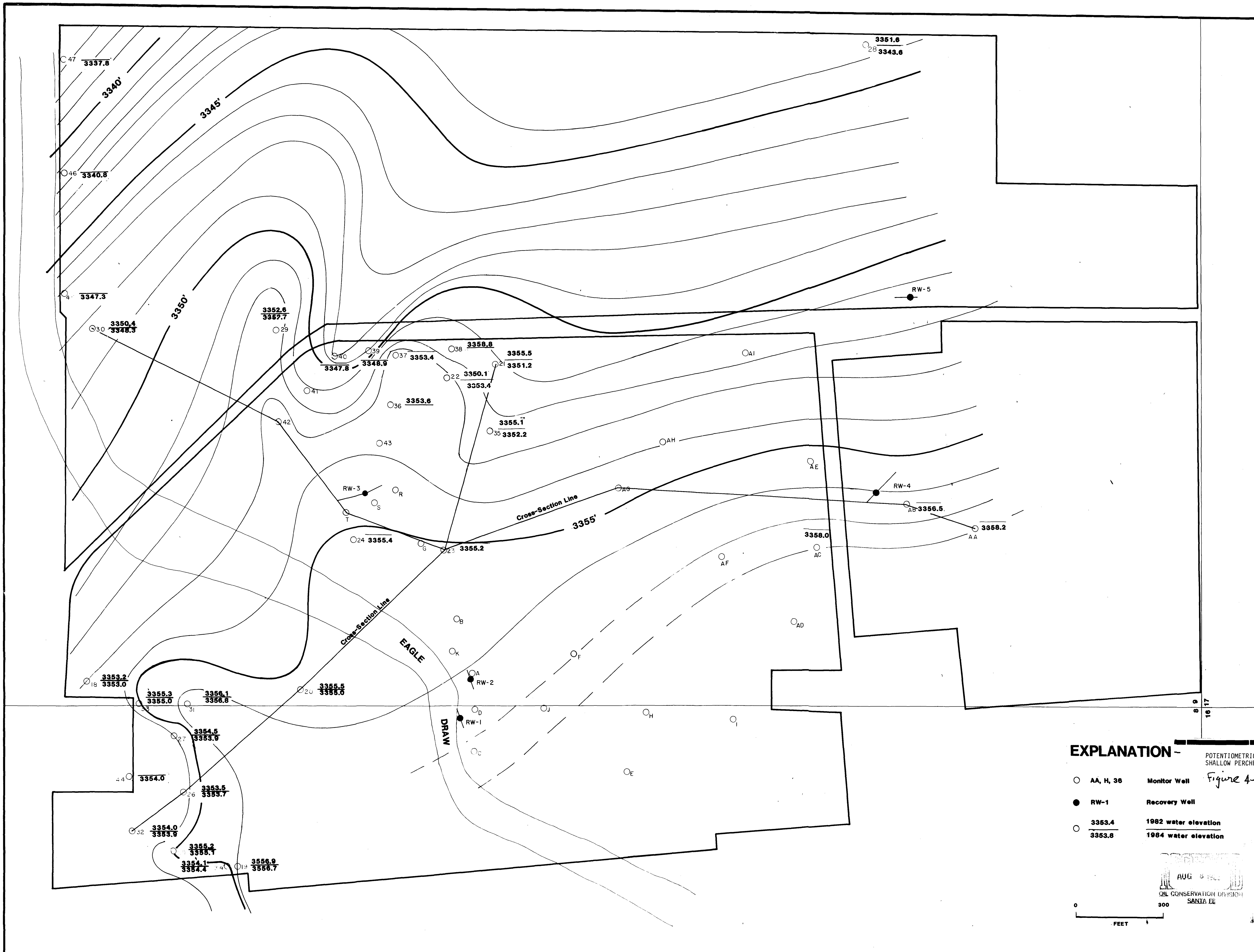
BOILERS

WQCC 3-103 PARAMETERS	S.D. BOILER BLOWDOWN (#2)	N.D. HIGH PRESSURE BOILER (#18)	N.D. LOW PRESSURE BOILER (#12)
As	.004	.005	.003
Ba	<.1	<.1	<.1
Cd	<.01	<.01	<.01
Cr	<.05	<.05	<.05
CN			
F	3.1	2.2	1.5
Pb	.18	.14	.05
Hg			
NO_3	.2	.1	.05
Se			
Ag	<.05	<.05	<.05
U	<.05	<.05	<.05
Cl	127	73	44
Cu	<.03	<.03	<.03
Fe	1.9	0.65	0.25
Mn	.07	<.03	<.03
SO	1549	1242	693
TDS	4220	2873	1807
Zn	.06	<.01	<.01
pH	11.6	11.6	11.2
Al	<1.0	<1.0	<1.0
B			
Co	<.01	.02	.01
Mo	<.5	<.5	<.5
Ni	<.05	<.05	<.05
Phenols			
TSS	20	0	0
Cond.	6000	5000	2800
COD	116	0	0
NH_4			
S			

Table 5-2 (continued)

COOLING TOWERS

WQCC 3-103 STANDARDS	N.D. COOLING TOWER BLOWDOWN (#10)	S.D. ALKY COOLING TOWER BLOWDOWN (#1)	S.D. TCC COOLING TOWER BLOWDOWN	N.D. FCC COOLING TOWER BLOWDOWN (#16)
As	.004	<.001	.011	.001
Ba	<.1	<.1	<.1	<.1
Cd	<.01	<.01	<.01	<.01
Cr	.06	1.05	<.05	0.22
CN				
F	1.6	4.4	2.2	1.6
Pb	.05	.05	<.05	.05
Hg				
NO_3	.5	.75	.2	.3
Se				
Ag	<.05	<.05	<.05	<.05
U	<.05	<.05	<.05	<.05
Cl	48	53	44	47
Cu	<.03	<.03	<.03	<.03
Fe	.05	.5	<.05	<.05
Mn	<.03	.07	<.03	<.03
SO	1077	1461	1236	1067
TDS[4]	1906	2732	1694	1973
Zn	.48	28	<.01	.17
pH	7.6	6.9	7.7	8.0
Al	<1.0	<1.0	1.0	<1.0
B				
Co	<.01	.01	.02	.01
Mo	<.5	<.5	<.5	<.5
Ni	<.05	<.07	<.05	<.05
Phenols				
TSS	13	0	67	0
Cond.	0	0	108	1800
COD	1850			15
NH_4	0			



Geoscience Consultants, Ltd.

POTENTIOMETRIC SURFACE

SHALLOW PERCHED AQUIFER

NAVAJO REFINING COMPANY ARTESIA, NEW MEXICO

CLIENT:	NAVAJO REFINING COMPANY
DATE:	[illegible] 1984
DRAWN BY:	[illegible]
CHECKED BY:	
REVISED:	
SCALE:	[illegible]

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS
CERTIFICATE NUMBER 6777
AIPG
RANDALL T. HICKS
CERTIFIED PROFESSIONAL GEOLOGIST


Well Location
Sampled Well
Dry Well
R. 26 E.
R. 27 E.
T. 17 S.
PECOS RIVER
PECOS RIVER
PECOS RIVER
EFFLUENT DITCH
POND 1
(3308)
POND 2
(3305)
POND 3
(3306)
DIKE (BREACHED)
3304'
3302'
3301'
3300'
3299'
3298'
3302.7
3302.1
3304.0
3300.5
3300.6
3299.3
3299.4
Water well
3297.8
3298
3299.2
3297.3
3309.9
3310.6
3314.6
3310.6
POTENTIOMETRIC SURFACE OF VALLEY FILL AQUIFER EVAPORATION POND AREA
N
Figure 4-9
OIL CONSERVATION
SANTA FE
Geoscience Consultants, Ltd.
POTENTIOMETRIC SURFACE
VALLEY FILL AQUIFER
EVAPORATION POND AREA
CLIENT: NAVAJO REFINING COMPANY
DATE:
DRAWN BY: James Hunter
CHECKED BY:
REVISED: JCH 12-28-84
SCALE: 1 inch equals 200 feet
Base Map by: R.E. Lamb Engineering
AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS
6777
AIPG
RANDALL T. HICKS
CERTIFIED PROFESSIONAL GEOLOGIST

Geoscience Consultants, Ltd.

HAND DELIVERED

March 5, 1985

Dave Boyer
NMOCD
P.O. Box 2088
Santa Fe, New Mexico 87501

RE: Responses to Comments:

Dear Mr. Boyer:

Please find enclosed our responses to several of your comments. We would like to discuss some of your comments with you prior to our submission of the final response.

Our responses, which follow the same numbering as your comments, are presented below. The effluent data is summarized in the attached report

If you have any questions regarding these responses let me know.

Sincerely,
GEOSCIENCE CONSULTANTS, LTD.

Randall Hicks

Randall T. Hicks
Vice President

Enclosure
RTH/pg

RECEIVED
MAR 06 1985
OIL CONSERVATION DIVISION
SANTA FE

500 Copper Avenue N.W. Suite 220, Albuquerque, New Mexico 87102 (505) 842-0001

RESPONSE TO NMOCD FEBRUARY 7, 1985 COMMENTS

DISCHARGE PLAN ISSUES

1) The attached letter of agreement assures that Navajo will comply with Section 1-203.A. of the WQCC regulations. A spill protection plan for the refinery is scheduled for submission on June 17, 1985.

2) We concur that the WQCC Regulations do not specifically exempt discharges regulated by RCRA or the New Mexico Hazardous Waste Regulations. However, it was never the intention of Navajo Refining Company to cover the RCRA regulated discharges under this discharge plan or any discharge plan. Our September 13, 1984 letter to Mr. Ramey included a preliminary outline for the discharge plan which provided for a brief description of the waste management systems regulated under RCRA. This discharge plan addresses only the discharges which are disposed in the evaporation ponds.

   Enclosed is a copy applicable portions of of Navajo's RCRA Part B Application. We urge NMOCD to carefully examine this document to determine if this application meets or exceeds WQCC regulatory standards for the RCRA facilities at Navajo. Only one copy of the RCRA Part B application is enclosed. It is submitted for your information only and should not be considered part of this discharge plan.

3 and 4) Enclosed is a plan to conduct further hydrogeologic studies at the refinery area to determine if:

   a) The water quality of Pecos Valley sand/silt aquifer is greater than 10,000 mg/l

   b) Any potential leakage from the evaporation ponds will affect ground water with a concentration less than 10,000 mg/l.

   c) The conveyance ditch has integrity and is protecting ground water

HYDROGEOLOGY

1) yes

2 and 9) Enclosed are legible copies of water well logs provided to Geoscience by the Roswell State Engineer's Office for the one mile perimeter around the refinery. Some of illegible sections of the well logs were, in fact, our own notes. These notes are now reproduced in the copies.

3) Examination of the enclosed well logs will show that no wells for domestic industrial or agricultural purposes (for which data exist) had been completed in either the

Pecos Valley sand/silt aquifer or the shallow perched confined water bearing unit within the area covered by the well logs.

4) Kelly, V.C., 1971. Sec References Cited of Sections 1.0-6.0.

5) Enclosed is a completed copy of the U.S. Soil Conservation Service Soil Survey of Eddy County from which Figure 4-2 was derived. It is available at most SCS offices. All soil data are derived from Table 4 of this publication.

6) The Queen Formation dips slightly to the east and the depth to the top of the Queen will vary. Figure 4-3 of the discharge plan shows the depth to the top of the Queen.

7) Noted

8) The Bower sand is locally identified by the oil industry as the bottom water sand within the Seven Rivers Formation. The sand is discontinuous and is identified only in the subsurface. The cross section in the discharge plan (Figure 4-3) show the extent in this sand. The wells completed in this sand demonstrate that the ground water in this unit is under artesian pressure.

10) Logs for these monitor wells do not exist. Details of the product recovery system will be provided in the plans and specifications to the discharge plan.

11) Enclosed

12) All of the wells drilled in the refinery area exhibit artesian conditions. This is demonstrated in the lithologic logs which identify the water-bearing units. There are not enough data to determine the source of the demonstrated artesian head in the unit.

13) The anomalies may be due to monitor wells tapping different water-bearing units under slightly different pressure conditions.

14) Reserved

15) Enclosed

16) See enclosed plan for hydrogeologic studies.

17) The correct pond level for Pond # 3 is 3305. Levels will vary seasonally.

18 and 19) Reserved

20) To be provided

21) To be provided

22) Revised figure 4-9 (hand delivered to NMOCD on January 25, 1984) shows the location of well 16 north and west of well # 13. A log for well #16 is in our copy of Appendix A. An additional copy of this well log is found in the enclosure.

23) Map will be provided. Contingencies will be presented in the final discharge plan.

WATER QUALITY

1) These aquifers cannot be affected by the discharge due to the demonstrated artesian conditions in these units. We have provided detailed site specific water quality data on "ground water most likely to be affected by the discharge" (see 3-106.C.3, WQCC regulations). Regional water quality data for these artesian aquifers is available in several reports cited in the discharge plan.

2) See enclosed plan for further hydrogeologic studies

3) See enclosed plan for further hydrogeologic studies

4) "well water" should read "water well". It's location is given in figure 4-9. No completion data are available for this well.

5 and 6) Reserved
7) Enclosed

8) Addressed in February 25, 1985 submission

PLANT PROCESSES

1) No

2 and 4) Plans and specifications will be submitted to the NMOCD engineer (WQCC Regulations 1-202) after Discharge Plan Approval. Phosphates are used in the boilers. Steam generation should volatilize many organic species. All ground water quality data for the refinery area is given in the discharge plan.

3) The TEL pond is not part of this discharge plan and is presently being closed under RCRA.

5) To be provided

6) Total chromium. The analyses for CN has not been repeated. The data is correct to the best of our knowledge.

7) Waste stream # 19 on Figure 5-2 should read #18. Unnumbered waste streams have not and will not be characterized.

8) No

DESCRIPTION OF HYDROGEOLOGIC STUDIES TO BE CONDUCTED AT NAVAJO REFINING COMPANY

EVAPORATION PONDS

In order to demonstrate that ground water with a TDS concentration of 10,000 mg/l or less will not be affected by potential leakage (discharges) from the unlined evaporation ponds, Navajo will demonstrate:

1) That the observed high TDS levels near the evaporation ponds are not a manifestation of a localized body of poor quality water.

2) That leakage will not result in exceedence of standards for any ground water in other areas or in other (lower) aquifers.

3) That high TDS ground water is a natural condition and not due to past practices of Navajo Refining Company.

4) That stream standards for the Pecos River will not be exceeded.

In order to make this demonstration the following tasks will be completed:

1) Two well points will be installed down gradient and one monitor well up gradient from the evaporation ponds. If required a third drivepoint will be installed down gradient from the ponds.

2) Water from these wells will be analyzed for specific conductance and TDS.

3) The water level in the wells will be measured and the flow regime determined

4) Water samples from the Pecos River (at low flow) will be analyzed

Figure 1 shows the proposed location of 1-1/4 inch well points, the 4" monitor well and the Pecos River sampling points for this demonstration.

The existing wells in the area of the evaporation pond are fully adequate for monitoring the potential effects of the evaporation ponds on ground water. The new well shown in figure 1 will monitor the ground water up gradient from the ponds. This well program is consistent with the requirement for a demonstration under 3-109.C.1. The existing wells may not establish the precise direction of flow of ground water in the Pecos River Valley silt/sand aquifer because the heads could be affected by fluctuations of the river level. More widely-spaced well data are necessary to establish the regional flow directions. The flow direction will be established and are expected to demonstrate that ground water with less than 10,000 mg/l TDS cannot be affected by any discharge from the ponds.

A one well, two well point program will be initiated in March. A fully penetrating well (30-35 feet deep) adjacent to the existing, up gradient wells is should demonstrate the existence of a confining layer below the sand/silt aquifer and confirm the poor water quality above and below the confining layer. This well will also replace the existing up gradient well. Two well points will be completed down gradient from the ponds to specifically determine the ground water flow regime.

Sampling of the Pecos River will also be conducted during a low flow period (January-April) to demonstrate that past practices have not caused, and potential future wastewater disposal practices will not result in, an exceedence of stream (surface water) standards. The flow direction in the sand/silt aquifer must be established in order to determine if and where the ground water which flows beneath the ponds discharges to surface water. It is at this ground water discharge point that surface water samples must be taken upgradient samples will also be analized.

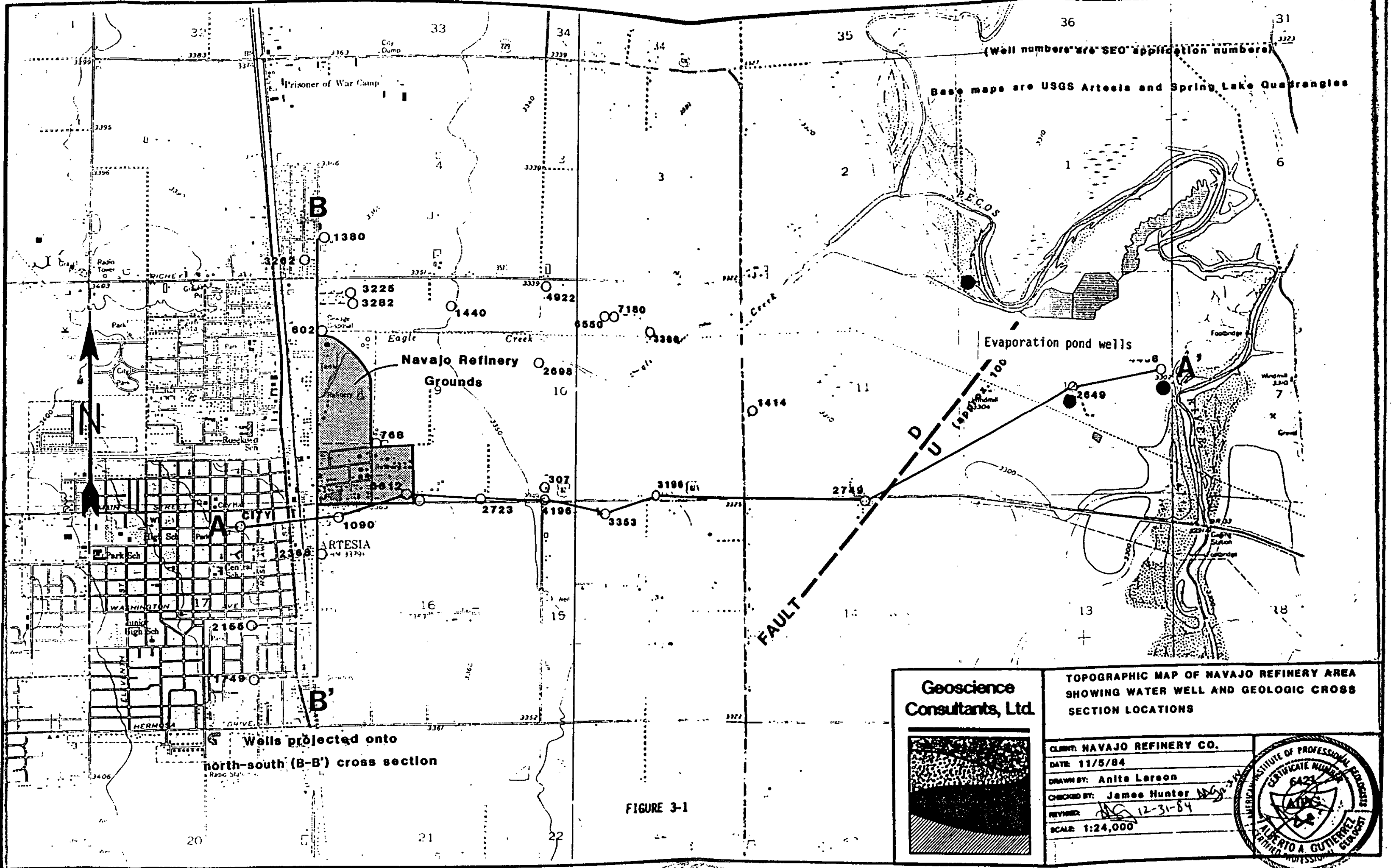
The data from this task should corroborate the existing data and demonstrate that:

1) The water quality in the Pecos River Valley silt/sand is greater than 10,000 mg/l TDS and

2) Stream standards will not be exceeded due to to the wastewater disposal practices of Navajo

FIRE WATER PONDS

A well down-gradient from the fire water ponds to monitor potential effects of seepage from the pond is not necessary. The existing monitor wells demonstrate artesian conditions and potential pond leakage should not affect the discharge plan approval process.



TOPOGRAPHIC MAP OF NAVAJO REFINERY AREA SHOWING WATER WELL AND GEOLOGIC CROSS SECTION LOCATIONS

CLIENT: NAVAJO REFINERY CO.
DATE: 11/5/84
DRAWN BY: Anita Larson
CHECKED BY: James Hunter
REVISED: 12-31-84
SCALE: 1:24,000

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS CERTIFICATE NUMBER 6421 ALBERTO A. GUTIERREZ CERTIFIED PROFESSIONAL GEOLOGIST

FIGURE 3-1

Table III-7
Sample Means for All Monitoring Parameters Through Fourth Quarter

Parameter	Unit	Well Number			
		31 upgradient	32 downgradient	33 downgradient	34 downgradient
Indicator					
pH	Std Units	7.39	7.29	7.37	7.31
Specific Conductance	umho/cm	2535	2753	3600	2143
Total Organic Carbon	mg/l	53	57	140	42
Total Organic Halogen	mg/l	0.048	0.100	0.288	0.112
Total Dissolved Solids	mg/l	1776	2529	2711	1614
Groundwater Quality					
Chloride	mg/l	119	160	179	157
Iron	mg/l	0.43	0.18	0.56	0.55
Manganese	mg/l	1.35	0.40	0.30	0.26
Phenols	mg/l	0.002	0.005	0.001	0.002
Sodium	mg/l	88	37	41	101
Sulfate	mg/l	539	1034	1414	415
Primary Drinking Water					
Arsenic	mg/l	0.005	0.005	0.005	0.009
Barium	mg/l	0.10	0.05	0.05	0.10
Cadmium	mg/l	0.0005	0.0005	0.0005	0.0005
Chromium	mg/l	0.0009	0.0014	0.0009	0.0015
Fluoride	mg/l	1.04	1.30	2.78	1.17
Lead	mg/l	0.0029	0.0030	0.0030	0.0036
Mercury	mg/l	0.06	0.06	0.06	0.11
Nitrate (as N)	mg/l	0.005	0.006	0.006	0.005
Selenium	mg/l	0.005	0.006	0.006	0.005
Silver	mg/l	0.005	0.005	0.005	0.005
Endrin	mg/l	0.0001	0.0001	0.0001	0.0001
Lindane	mg/l	0.002	0.002	0.002	0.002
Methyoxychlor	mg/l	0.05	0.05	0.05	0.05
Toxaphene	mg/l	0.0025	0.0025	0.0025	0.0025
2,4-D	mg/l	0.05	0.05	0.05	0.05
2,4,5-TP Silvex	mg/l	0.005	0.005	0.005	0.005
Turbidity	Jackson Units	112	31	95	98
Coliform	col/100 ml	0.5	50	0.5	50,000

*Note: When analytical result reported as less then detection limit, value assumed to be one half of detection limit.

Table III-3

North Colony Landfarm
First Quarter Groundwater Monitoring Results
(Sampled 11-1-82 and 12-1-82)

Parameter	Unit	Well Number 31 upgradient	32 downgradient	33 downgradient	34 downgradient
Indicator					
pH	Std. Units	7.31*	7.41	7.41	7.30
Specific Conductance	umho/cm	2545*	2693	3590	2563*
Totol Organic Carbon	mg/l	63*(49)	240(8)	625(14)	25(64)
Total Organic Halogen	mg/l	0.042*	0.102	0.065	0.026
Total Dissolved Solids	mg/l	1434	2014	2812	1684
Groundwater Quality					
Chloride	mg/l	89(105)	116(125)	163(170)	173(180)
Iron	mg/l	0.06	<0.01	<0.01	1.81
Manganese	mg/l	1.08	0.311	0.521	0.567
Phenols	mg/l	<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	100(86)	35.4(36)	44.4(39)	88.5(92)
Sulfate	mg/l	423(540)	1049(1120)	1428(1310)	613(430)
Primary Drinking Water					
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.1	<0.1	<0.1	0.1
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001
Chromium	mg/l	<0.001	<0.001	<0.001	0.004
Fluoride	mg/l	1.15	1.28	2.70	1.28
Lead	mg/l	0.002	0.001	0.001	0.005
Mercury	mg/l	<0.0004	<0.0004	<0.0004	<0.0004
Nitrate (as N)	mg/l	0.1	0.1	<0.1	<0.1
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01
Silver	mg/l	<0.01	<0.01	<0.01	<0.01
Pesticides & Herbicides	--	ND	ND	ND	ND
Radioactivity		samples not analyzed due to high TDS			
Turbidity	Jackson Units	75	40	30	190
Coliform	col/100 ml	1	200	1	200,000

* average of four replicates

values in parentheses are the results of resampling (12-1-82) and reanalysis.

Table III-4
North Colony Landfarm
Second Quarter Groundwater Monitoring Results
(Sampled 2-24-83)

Parameter	Unit	Well Number 31 upgradient	32 downgradient	33 downgradient	34 downgradient
Indicator					
pH	Std Units	7.0	6.7	6.8	7.1
Specific Conductance	umho/cm	2135*	2300	3030	1900
Total Organic Carbon	mg/l	88*	10	20	20
Total Organic Halogen	mg/l	0.038*	0.037	0.017	0.043
Total Dissolved Solids	mg/l	1810	3290	2790	1510
Groundwater Quality					
Chloride	mg/l	120	150	150	140
Iron	~~mg/l~~	~~0.88~~	~~0.09~~	~~0.30~~	~~0.03~~
Manganese	mg/l	1.5	0.439	0.234	0.260
Phenols	mg/l	0.006	<0.001	0.001	0.005
Sodium	mg/l	81	33	40	43
Sulfate	mg/l	690	990	1450	440
Primary Drinking Water					
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.2	<0.1	<0.1	0.1
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001
Chromium	mg/l	0.002	0.004	0.002	0.001
Fluoride	mg/l	1.3	1.7	3.5	1.4
Lead	mg/l	<0.001	<0.001	<0.001	<0.001
Mercury	mg/l	<0.0004	<0.0004	<0.0004	<0.0004
Nitrate (as N)	mg/l	<0.1	<0.1	<0.1	<0.1
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01
Silver	mg/l	<0.01	<0.01	<0.01	<0.01
Pesticides & Herbicides	--	ND	ND	ND	ND
Radioactivity		samples not analyzed due to high TDS			
Turbidity	Jackson Units	175	40	110	75
Coliform	col/100 ml	<1	<1	<1	<1

* average of four replicates

Table III-5
North Colony Landfarm
Third Quarter Groundwater Monitoring Results
(Sampled 7-14-83)

Parameter	Unit	Well Number 31 upgradient	32 downgradient	33 downgradient	34 downgradient
Indicator					
pH	Std Units	7.56*	7.59	7.46	7.47
Specific Conductance	umho/cm	3040*	3900	5100	2400
Total Organic Carbon	mg/l	37*	14	21	25
Total Organic Halogen	mg/l	<0.05*	0.184	0.748	0.336
Total Dissolved Solids	mg/l	2130	2730	3570	1680
Groundwater Quality					
Chloride	mg/l	130	200	200	140
Iron	mg/l	<0.01	0.32	0.74	0.09
Manganese	mg/l	0.814	0.335	0.165	0.085
Phenols	mg/l	<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	86	37	40	61
Sulfate	mg/l	520	1000	1480	330
Primary Drinking Water					
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.1	<0.1	<0.1	0.1
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001
Chromium	mg/l	<0.001	<0.001	<0.001	<0.001
Fluoride	mg/l	0.82	1.1	2.5	1.0
Lead	mg/l	0.003	0.003	0.005	0.003
Mercury	mg/l	<0.0004	<0.0004	<0.0004	<0.0004
Nitrate (as N)	mg/l	<0.1	<0.1	0.1	0.3
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01
Silver	mg/l	<0.01	<0.01	<0.01	<0.01
Pesticides & Herbicides	--	ND	ND	ND	ND
Radioactivity		samples not analyzed due to high TDS			
Turbidity	Jackson Units	75	40	220	40
Coliform	col/100 ml	1	1	1	1

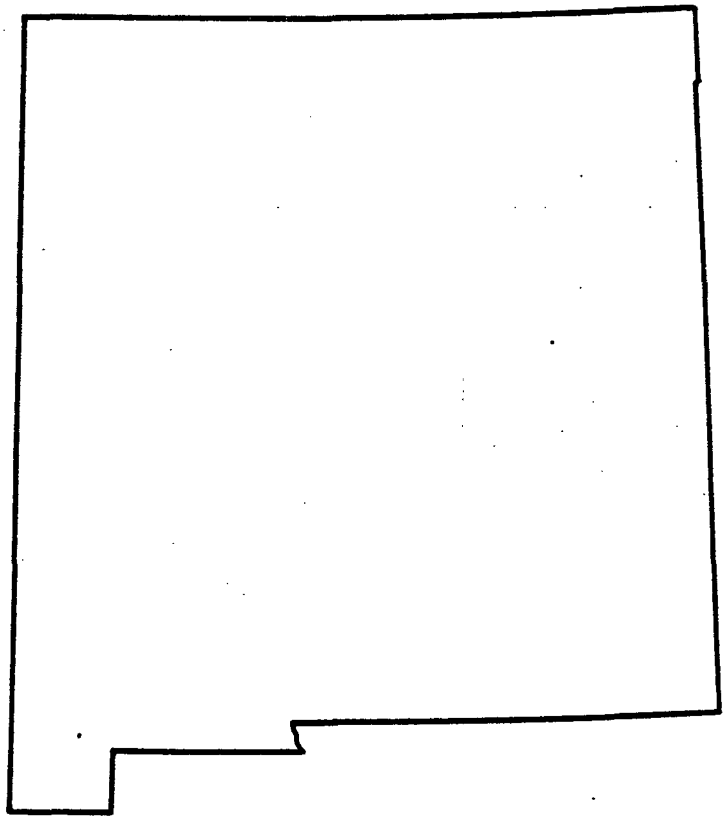
* average of four replicates

Table III-6
North Colony Landfarm
Fourth Quarter Groundwater Monitoring Results
(Sampled 10-3-83)

Parameter	Unit	Well Number 31 upgradient	32 downgradient	33 downgradient	34 downgradient
Indicator					
pH	Std Units	7.40	7.44	7.82	7.36
Specific Conductance	umho/cm	2076	2120	2680	1710
Total Organic Carbon	mg/l	26*	12	20	75
Total Organic Halogen	mg/l	0.063*	0.077	0.321	0.044
Total Dissolved Solids	mg/l	1730	2050	1670	1580
Groundwater Quality					
Chloride	mg/l	150	210	210	150
Iron	mg/l	0.77	0.30	1.2	0.28
Manganese	mg/l	1.99	0.502	0.272	0.115
Phenols	mg/l	<0.001	<0.001	<0.001	<0.001
Sodium	mg/l	85	43	44	62
Sulfate	mg/l	520	1010	1400	260
Primary Drinking Water					
Arsenic	mg/l	<0.01	<0.01	<0.01	0.02
Barium	mg/l	<0.1	<0.1	<0.1	<0.1
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001
Chromium	mg/l	<0.001	<0.001	<0.001	<0.001
Fluoride	mg/l	0.9	1.1	2.4	1.0
Lead	mg/l	0.006	0.006	0.007	0.006
Mercury	mg/l	<0.0004	<0.0004	<0.0004	<0.0004
Nitrate (as N)	mg/l	<0.1	<0.1	<0.1	<0.1
Selenium	mg/l	<0.01	0.01	0.01	<0.01
Silver	mg/l	<0.01	<0.01	<0.01	<0.01
Pesticides & Herbicides	--	ND	ND	ND	ND
Radioactivity		samples not analyzed due to high TDS			
Turbidity	Jackson Units	123	26	19	88
Coliform	col/100 ml	1	1	1	1

* *average of four replicates*

Water Resources Data New Mexico Water Year 1982



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NM-82-1
Prepared in cooperation with the State of New Mexico
and with other agencies

08396500 PECOS RIVER NEAR ARTESIA, NM
(Surveillance program station)

LOCATION.--Lat 32°50'27", long 104°19'23", in NW¼NW¼ sec.18, T.17 S., R.27 E., Eddy County, Hydrologic Unit 13060007, on left bank 250 ft (76 m) upstream from bridge on State Highway 83, 4.3 mi (6.9 km) east of Artesia, 7.0 mi (11.3 km) upstream from Rio Penasco, 17 mi (27.4 km) upstream from McMillan Dam, and at mile 503.9 (810.8 km). Prior to Apr. 3, 1981, at site 250 ft (76 m) downstream.

DRAINAGE AREA.--15,300 mi^2 (39,630 km^2), approximately (contributing area).

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--September 1905 to June 1909, August 1909 to current year. Monthly discharge only for some periods, published in WSP 1312 and 1712. Records for Aug. 22-31, 1934, and October 1936 to April 1937, published in WSP 763 and 828, respectively are not reliable and should not be used. Prior to February 1936, published as "near Dayton."

REVISED RECORDS.--WSP 1312 and 1512: 1913, 1915, 1917-18(M), 1920, 1923, 1931-36. WSP 1712: 1906(M), 1908-11(M), 1919, 1921-23(M), 1929, 1931-32(M), 1935-36(M), 1937, 1939(M), 1941(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 3,291.92 ft (1,003.376 m) National Geodetic Vertical Datum of 1929. See WSP 1923 or 2123 for history of changes prior to Apr. 5, 1941. Apr. 5, 1941 to Apr. 2, 1981, water-stage recorder at site 250 ft (76 m) downstream at same datum.

REMARKS.--Water-discharge records fair. Flow regulated by Santa Rosa Lake (station 08382810) since Arpil 1980, by Lake Sumner (station 08384000) since August 1937, and by Two Rivers Reservoir (station 08390600) since July 1963. Diversions and ground-water withdrawals for irrigation of about 154,000 acres (620 km^2), 1959 determination, above station.

AVERAGE DISCHARGE.--46 years, 244 ft^3/s (6.910 m^3/s), 176,800 acre-ft/yr (218 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge probably occurred May 30, 1937, when a discharge of 51,500 ft^3/s (1,460 m^3/s) was measured by slope-area method at a point 15 mi (24.1 km) upstream, gage height, 14.7 ft (4.48 m), site and datum then in use; no flow at times in 1934, 1946-47, 1953-54, 1957, 1964-65.

EXTREMES OUTSIDE PERIOD OF RECORD.--Greatest flood since at least 1893 occurred Oct. 2, 1904, discharge not determined; the peak inflow to Lake McMillan, which includes Rio Penasco and Fourmile Draw, was estimated at 82,000 ft^3/s (2,320 m^3/s). The second highest flood occurred July 25, 1905, discharge below Rio Penasco, 50,300 ft^3/s (1,420 m^3/s), based on gain in storage and spill from Lake McMillan. The floods in August 1893and October 1904 damaged McMillan Dam and washed out Avalon Dam.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,070 ft^3/s (58.6 m^3/s) at 2230 hours Sept. 15, gage height, 10.15 ft (3.094 m) from floodmarks, no other peak above base of 2,000 ft^3/s (57 m^3/s); minimum, 1.3 ft^3/s (0.037 m^3/s) Sept. 2.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	56	96	59	53	58	49	23	885	24	70	25	2.1
2	53	95	62	53	57	49	24	845	19	55	30	1.3
3	87	88	62	53	56	48	24	754	16	154	37	4.9
4	57	83	62	53	56	42	25	517	13	483	57	129
5	95	77	62	52	56	40	25	246	11	537	87	564
6	117	92	62	51	56	39	24	177	10	620	56	654
7	109	104	62	51	56	39	23	143	11	760	34	684
8	269	93	62	51	56	40	24	117	8.6	740	32	713
9	182	83	61	51	55	41	24	106	7.3	800	22	744
10	164	71	60	50	56	40	22	98	7.7	930	18	750
11	168	67	60	50	59	38	26	81	6.4	920	15	758
12	153	64	60	50	59	36	27	66	11	880	8.0	755
13	127	64	60	50	59	39	29	58	7.5	1100	6.0	769
14	107	64	60	50	58	41	28	50	5.5	900	6.0	842
15	95	65	60	115	58	39	26	51	5.3	911	5.0	973
16	88	65	60	120	59	35	550	50	5.7	900	6.0	1240
17	78	64	59	120	59	35	662	48	13	878	6.5	966
18	73	60	58	110	55	36	715	38	8.6	849	5.5	710
19	71	55	58	62	51	35	752	35	9.2	798	6.0	324
20	69	58	58	64	49	34	805	32	8.1	549	4.0	454
21	67	58	57	69	49	32	832	26	8.3	190	4.5	307
22	67	59	56	77	49	31	850	22	8.1	146	3.5	256
23	72	56	55	89	48	32	875	19	14	106	3.5	203
24	60	54	55	86	48	29	965	20	11	87	4.0	181
25	86	53	54	78	49	26	888	27	8.6	92	4.0	166
26	97	53	54	74	49	25	862	25	6.9	55	7.0	165
27	101	50	54	69	49	25	818	27	8.0	38	30	148
28	94	52	54	65	49	26	812	32	6.9	39	35	128
29	102	54	53	61	---	24	815	36	7.8	31	20	99
30	103	56	53	60	---	21	770	29	19	25	10	82
31	93	---	53	58	---	20	---	25	---	22	7.0	---
TOTAL	3180	2053	1805	2095	1518	1086	12345	4685	305.5	14665	594.5	13772.3
MEAN	103	68.4	58.2	67.6	54.2	35.0	412	151	10.2	473	19.2	459
MAX	269	104	62	120	59	49	965	885	24	1100	87	1240
MIN	53	50	53	50	48	20	22	19	5.3	22	3.5	1.3
AC-FT	6310	4070	3580	4160	3010	2150	24490	9290	606	29090	1180	27320

CAL YR 1981 TOTAL 33069.8 MEAN 90.6 MAX 788 MIN 3.0 AC-FT 65590
WTR YR 1982 TOTAL 58104.3 MEAN 159 MAX 1240 MIN 1.3 AC-FT 115230

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

ONCE-DAILY

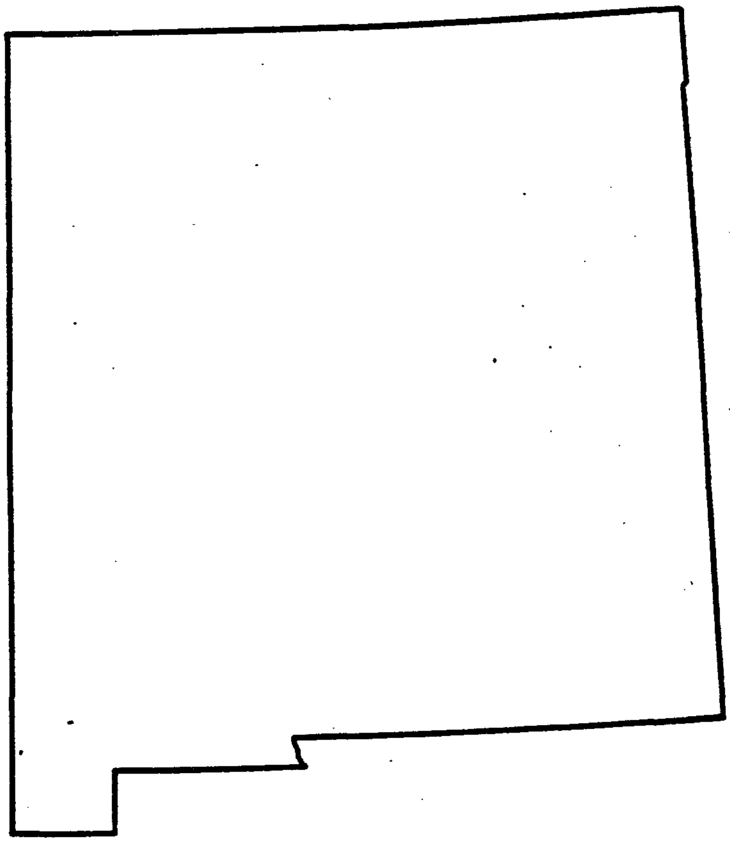
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8650	6130	9810	9900	10200	11000	13700	2780	10600	11200	8220	7430
2	8580	6400	10100	10000	10300	11100	14200	2830	11200	11100	8510	8100
3	8890	6610	10100	9960	10200	11200	14300	2820	11900	9080	7980	9270
4	5750	6580	9350	10100	10300	11300	14000	3070	12800	3720	6550	9690
5	5780	7030	9270	10000	10200	11300	13800	3190	15600	3010	3940	3080
6	9220	6350	8840	10100	10200	11300	----	3510	15200	2410	4390	2020
7	9200	6320	9180	10200	10200	11100	----	3710	15400	1720	4650	1690
8	5300	6190	9170	10100	10100	11200	----	4090	16900	1600	5780	1550
9	5260	6720	9440	10100	10100	11100	----	4370	16400	1370	6930	1520
10	5230	7150	9870	10200	9920	11100	----	4600	15800	1380	7030	1350
11	5210	7550	9850	10400	9870	11500	----	4790	16700	1310	7950	1270
12	4070	8000	9890	10100	10600	11700	----	5190	17300	1230	9500	1120
13	4060	8350	9900	10100	10200	11800	----	5340	18700	1180	9810	1090
14	5360	8390	9940	9820	10100	11500	----	5930	21100	1400	9880	1030
15	6070	8700	9700	9830	10200	11600	----	6370	20600	1170	10500	350
16	6690	8880	9750	9850	9940	11500	----	6870	18700	1120	12400	920
17	7090	8980	9620	11200	9690	12100	----	7760	20600	1100	12700	970
18	7080	8250	10000	11200	10000	12100	----	7630	22200	1100	15600	930
19	7720	9080	10000	9240	10100	11800	----	8140	17600	1110	15900	1260
20	8030	9070	10100	9310	10100	12000	----	8910	16400	1230	16700	1380
21	8290	9280	10100	10900	10700	12200	----	10700	17900	1560	16400	1430
22	8320	9220	10100	10500	[illegible]	12100	----	10700	17200	1570	16000	2000
23	8330	9510	10200	9750	10800	12000	----	10200	17400	1770	17000	1820
24	8400	9480	10200	[illegible]	10700	12700	----	10200	17600	1770	16400	1940
25	7680	9700	10100	[illegible]	[illegible]	12300	----	13000	15000	2080	16700	2230
26	7140	9670	10100	[illegible]	10800	12900	----	10400	14000	2760	18200	2150
27	6430	9910	10400	9120	11000	12900	2840	10300	14100	3430	19300	2730
28	6440	9900	10400	9150	10900	13100	2820	10100	14800	4170	18700	2900
29	5820	9850	10300	9620	----	12900	2800	9930	18300	4480	25200	3120
30	5800	9670	10400	10000	----	13400	2830	9680	7430	5210	7460	3530
31	6090	----	10100	10200	----	13800	----	10700	----	7980	7180	----
MEAN	6840	8230	9880	9880	10300	11900	7780	7030	16200	3070	11700	2660

WTR YR 1982 MEAN 8790 MAX 25200 MIN 350

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), RECORDER MAXIMUM, MINIMUM, AND MEAN, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		FEBRUARY			MARCH			APRIL			MAY	
1							14800	13000	14000			
2							14800	12700	13400			
3							14400	12200	13300			
4							14400	12500	13400			
5							14300	12200	13200			
6							13100	12100	12500			
7							13400	12100	12700			
8							14000	11800	12700			
9							13500	11700	12400			
10							12700	10800	11700			
11							12100	10400	11200			
12							11400	10000	10800			
13							10700	2600	9710			
14							10100	2100	9400			
15							10700	2500	8920			
16							9000	4370	5870			
17							4310	3790	4020			
18							3820	2850	3560			
19							2940	2700	2810			
20							2780	2690	2730			
21							2720	2580	2660			
22							2640	2560	2590			
23							2580	2550	2560			
24							2710	2540	2610			
25							2790	2570	2680			
26							2700	2580	2620			
27							----	----	----			
28							----	----	----			
29							----	----	----			
30							----	----	----			
31							----	----	----			
MONTH							14800	2100	8230			

Water Resources Data New Mexico Water Year 1983



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NM-83-1
Prepared in cooperation with the State of New Mexico
and with other agencies

08396500 PECOS RIVER NEAR ARTESIA, NM
(Surveillance program station)

LOCATION.--Lat 32°50'27", long 104°19'23", in NW¼NW¼ sec.18, T.17 S., R.27 E., Eddy County, Hydrologic Unit 13060007, on left bank 250 ft upstream from bridge on State Highway 83, 4.3 mi east of Artesia, 7.0 mi upstream from Rio Penasco, 17 mi upstream from McMillan Dam, and at mile 503.9.

DRAINAGE AREA.--15,300 mi^2, approximately (contributing area).

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--September 1905 to June 1909, August 1909 to current year. Monthly discharge only for some periods, published in WSP 1312 and 1712. Records for Aug. 22-31, 1934, and October 1936 to April 1937, published in WSP 763 and 828, respectively are not reliable and should not be used. Prior to February 1936, published as "near Dayton."

REVISED RECORDS.--WSP 1312 and 1512: 1913, 1915, 1917-18(M), 1920, 1923, 1931-36. WSP 1712: 1906(M), 1908-11(M), 1919, 1921-23(M), 1929, 1931-32(M), 1935-36(M), 1937, 1939(M), 1941(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 3,291.92 ft National Geodetic Vertical Datum of 1929. See WSP 1923 or 2123 for history of changes prior to Apr. 5, 1941. Apr. 5, 1941 to Apr. 2, 1981, water-stage recorder at site 250 ft downstream at same datum.

REMARKS.--Records fair. Flow regulated by Santa Rosa Lake (station 08382810) since April 1980, by Lake Sumner (station 08384000) since August 1937, and by Two Rivers Reservoir (station 08390600) since July 1963. Diversions and ground-water withdrawals for irrigation of about 154,000 acres, 1959 determination, above station.

AVERAGE DISCHARGE.--47 years, (1937-83), 243 ft^3/s, 176,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge probably occurred May 30, 1937, when a discharge of 51,500 ft^3/s was measured by slope-area method at a point 15 mi upstream, gage height, 14.7 ft, site and datum then in use; no flow at times in 1934, 1946-47, 1953-54, 1957, 1964-65.

EXTREMES OUTSIDE PERIOD OF RECORD.--Greatest flood since at least 1893 occurred Oct. 2, 1904, discharge not determined; the peak inflow to Lake McMillan, which includes Rio Penasco and Fourmile Draw, was estimated at 82,000 ft^3/s. The second highest flood occurred July 25, 1905, discharge below Rio Penasco, 50,300 ft^3/s, based on gain in storage and spill from Lake McMillan. The floods in August 1893 and October 1904 damaged McMillan Dam and washed out Avalon Dam.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 895 ft^3/s May 16, gage height, 6.59 ft, no peak above base of 2,000 ft^3/s; minimum, 0.17 ft^3/s Aug. 21.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	73	71	73	63	61	45	26	14	74	7.9	98	363
2	202	66	68	62	60	48	22	20	77	50	96	405
3	645	62	69	59	59	47	24	21	75	242	92	440
4	429	59	66	65	58	46	29	24	68	591	90	492
5	231	51	62	64	60	42	32	23	45	630	76	458
6	193	58	58	64	62	38	33	189	38	716	56	487
7	157	57	57	64	68	40	44	544	34	730	33	518
8	129	61	55	65	68	37	47	637	31	740	26	521
9	113	55	56	68	66	35	53	685	28	760	26	746
10	97	49	61	68	65	34	64	721	26	750	19	727
11	88	49	62	69	62	34	69	729	22	742	13	656
12	74	51	73	69	61	34	68	750	16	760	10	690
13	69	53	73	69	60	34	58	798	13	780	11	685
14	62	52	72	65	58	34	51	825	15	803	11	622
15	62	51	74	62	57	34	50	872	18	792	10	614
16	78	46	74	61	56	31	58	873	17	860	12	614
17	77	44	68	60	51	27	56	822	15	843	8.0	607
18	77	46	67	59	48	28	39	816	14	837	5.8	595
19	78	47	64	58	46	27	31	839	12	819	5.7	600
20	81	47	62	58	46	27	23	794	11	806	5.4	527
21	81	47	60	61	45	27	20	802	11	818	4.7	424
22	78	47	58	64	45	29	19	796	15	802	5.3	219
23	74	45	58	65	45	25	21	715	11	832	5.5	166
24	72	44	58	69	45	23	21	313	9.0	815	4.7	135
25	70	43	56	70	46	24	23	203	9.0	821	5.1	100
26	72	43	56	70	46	29	23	153	10	829	6.7	88
27	75	50	59	70	44	32	15	109	20	839	8.1	76
28	78	57	57	69	43	33	15	92	10	720	7.4	74
29	78	64	57	66	---	34	15	81	13	500	5.6	74
30	73	77	65	63	---	31	12	71	10	202	65	75
31	71	---	61	61	---	30	---	69	---	119	302	---
TOTAL	3837	1592	1959	2000	1531	1039	1061	14400	767.0	20555.9	1124.0	12798
MEAN	124	53.1	63.2	64.5	54.7	33.5	35.4	465	25.6	663	36.3	427
MAX	645	77	74	70	68	48	69	873	77	860	302	746
MIN	62	43	55	58	43	23	12	14	9.0	7.9	4.7	74
AC-FT	7610	3160	3890	3970	3040	2060	2100	28560	1520	40770	2230	25380

CAL YR 1982 TOTAL 58454.3 MEAN 160 MAX 1240 MIN 1.3 AC-FT 115900
WTR YR 1983 TOTAL 62663.9 MEAN 172 MAX 873 MIN 4.7 AC-FT 124300

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5000	6070	7160	8520	8540	10200	12100	14500	4830	13200	1890	2940
2	3990	6180	6900	8230	8530	10100	12500	14400	5190	13300	2180	2830
3	1940	6230	6830	8660	8720	9890	13200	13300	5330	13400	2720	2300
4	1530	6720	6900	8430	8700	10300	10900	11900	5060	13700	3070	1590
5	1680	6800	6830	8450	8700	10400	10900	10700	4810	17600	2900	1520
6	1860	7190	6890	8260	8580	10400	9950	11000	6070	16600	3180	1120
7	1980	7140	7200	8410	8550	10800	10200	4020	6470	15300	3940	1090
8	2270	6760	7330	8290	8280	10900	9120	3670	6470	1280	4680	1060
9	2710	6880	7540	8580	8430	11200	9470	3090	6960	1250	5660	1100
10	2740	6890	8230	8110	8410	11300	9890	3040	7950	1170	5140	1160
11	4060	7210	7160	8050	8360	11300	9710	2920	8160	1150	5970	1050
12	4630	7380	7460	8050	8580	11400	9640	2920	8890	1150	6770	997
13	5280	7310	7480	7950	8740	11500	8460	2890	9920	1130	9500	1010
14	5480	7560	7450	8080	8790	11700	8440	2850	11900	1100	8820	981
15	5890	7670	7330	7940	8800	11600	8800	2940	10500	1060	8660	1050
16	5590	7670	6970	7960	9000	11700	8660	2870	10300	1060	9000	1070
17	5380	7790	6940	8550	9490	12100	8270	2690	9260	1170	9020	1090
18	5280	7870	7080	8530	9770	12400	8620	2630	11700	1010	8110	1090
19	5220	7900	7300	8780	9840	12400	9310	2450	12800	960	9160	1110
20	5210	8320	7550	8870	9970	12400	9470	2430	13000	980	8950	1080
21	4940	8360	7810	8740	9920	12700	10800	2420	13500	970	8860	1110
22	5110	8370	7990	8300	9890	12100	11500	2400	14200	960	9730	1300
23	5280	8280	8150	8430	9970	12100	12700	2430	13800	960	11200	1430
24	5530	8180	8320	8430	10100	12700	13200	2740	11700	960	11000	1910
25	5500	8050	8460	8120	9820	13400	13100	2790	12200	1030	11100	2030
26	5490	7800	8500	8050	9950	13200	12100	2850	6250	1010	15400	2780
27	5280	7570	8360	8140	10000	12500	12800	2960	5640	1080	18500	3020
28	5310	7540	8340	8140	9950	10900	14700	3080	6990	1470	18000	3410
29	5400	7620	8310	8240	---	10900	14600	3180	10900	1530	13800	3680
30	5380	7120	8210	8330	---	10900	15100	4270	11400	1650	14200	4350
31	5670	---	8610	8430	---	11300	---	4570	---	1730	12900	---
MEAN	4410	7410	7600	8320	9160	11500	10900	4870	9070	4220	8520	1740

WTR YR 1983 MEAN 7300 MAX 18500 MIN 960

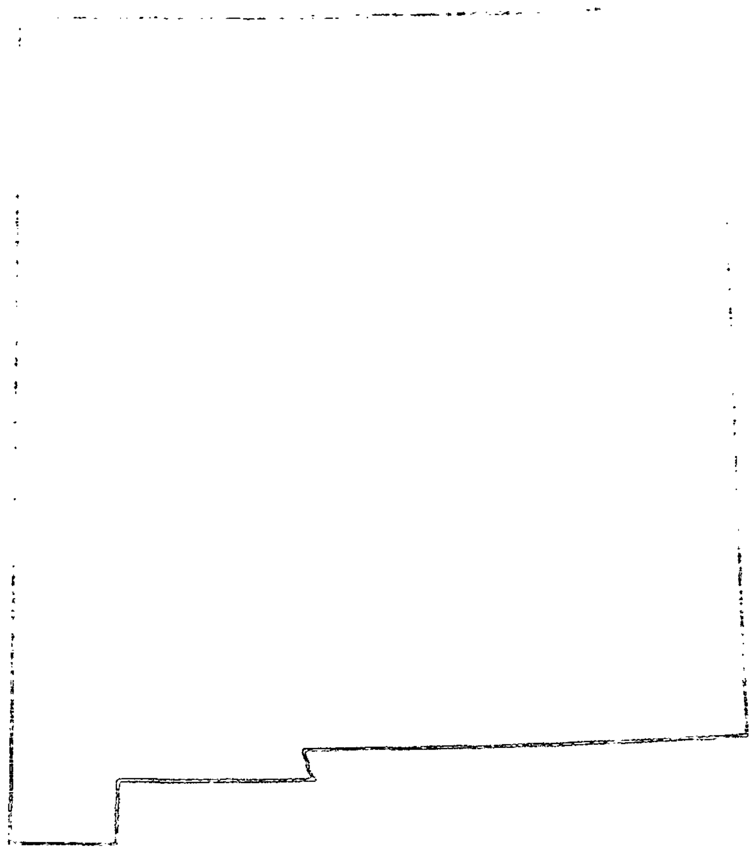
TEMPERATURE WATER (DEG.° C), WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25.0	17.5	10.0	.5	8.0	18.0	12.0	17.0	19.0	30.0	24.0	29.0
2	22.0	14.0	9.5	3.0	9.0	18.0	14.0	20.5	25.0	28.0	30.0	26.0
3	19.0	13.0	5.0	.0	9.5	18.5	19.5	15.0	25.0	30.5	30.5	26.0
4	19.0	10.0	9.0	.0	7.0	13.5	7.5	20.5	27.5	28.5	29.5	26.5
5	21.0	13.5	9.0	3.5	6.5	12.0	8.0	20.0	20.0	25.0	26.0	28.5
6	23.0	15.0	6.0	5.5	8.5	10.0	5.0	21.0	23.0	25.0	23.5	24.5
7	19.0	11.0	10.0	4.5	8.0	14.5	7.0	18.0	27.5	25.5	30.0	27.0
8	21.0	12.0	6.0	6.5	12.5	19.0	8.0	21.0	27.0	26.0	28.5	27.0
9	18.0	17.5	7.0	8.5	9.0	18.0	16.0	20.5	22.0	26.5	25.5	25.0
10	19.0	15.5	5.0	9.0	9.0	21.0	15.5	21.0	21.0	27.0	24.5	25.0
11	18.0	14.0	5.0	9.5	14.0	12.5	15.0	21.0	31.0	27.0	31.0	27.0
12	15.0	13.0	5.0	8.0	9.0	19.0	20.5	19.5	29.0	27.5	25.0	26.0
13	15.5	12.5	9.0	6.5	14.0	21.0	15.0	19.0	28.5	27.5	30.0	24.0
14	13.0	9.5	5.0	9.5	10.0	21.0	11.0	18.5	22.5	25.0	26.0	25.0
15	20.5	8.0	8.0	8.5	15.0	17.0	20.5	18.0	24.5	27.0	29.0	24.5
16	16.0	9.0	5.0	11.0	11.0	16.0	22.0	19.0	30.0	28.0	26.5	25.5
17	15.5	8.5	6.0	9.5	12.0	10.0	15.0	21.0	28.0	25.5	30.0	23.0
18	17.0	12.0	7.5	10.0	12.5	18.0	22.0	20.0	32.0	26.0	30.5	25.0
19	21.5	13.0	7.5	11.0	15.0	12.0	15.0	17.0	31.0	28.0	30.0	24.0
20	16.0	15.0	6.5	11.0	13.0	10.5	23.0	19.0	29.0	25.0	28.0	26.0
21	18.5	14.5	7.0	9.0	13.0	11.0	15.5	18.0	27.0	27.0	29.0	22.0
22	13.0	12.5	7.5	7.0	10.0	17.0	15.0	18.5	27.5	28.0	26.5	20.0
23	18.0	7.5	7.0	9.0	13.0	14.5	15.0	20.5	24.0	26.0	25.0	17.5
24	16.0	8.5	10.5	5.5	13.0	12.0	23.5	24.0	23.0	26.5	25.0	22.0
25	15.5	7.0	6.5	11.0	12.0	14.5	18.0	21.0	21.5	27.5	31.0	20.0
26	15.0	5.0	9.0	9.0	10.5	16.0	18.0	24.5	27.0	25.5	27.0	25.0
27	17.0	4.5	4.0	7.5	13.0	11.0	26.0	20.5	23.0	29.0	30.5	25.0
28	15.0	6.5	4.0	12.0	11.5	15.0	25.0	25.0	21.0	28.0	26.0	27.0
29	18.0	9.0	3.0	10.0	---	20.0	23.0	23.0	31.0	29.5	25.0	23.0
30	17.0	11.0	3.0	8.0	---	21.5	18.5	25.0	29.0	29.5	29.0	22.5
31	16.5	---	2.0	11.0	---	23.0	---	19.5	---	27.5	27.0	---
MEAN	18.0	11.5	6.5	7.5	11.0	16.0	16.5	20.0	26.0	27.0	27.5	24.5

WTR YR 1983 MEAN 17.5 MAX 32.0 MIN .0

Water Resources Data New Mexico

Water Year 1982



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NM-82-1

Prepared in cooperation with the State of New Mexico
and with other agencies

08396500 PECOS RIVER NEAR ARTESIA, NM
(Surveillance program station)

LOCATION.--Lat 32°50'27", long 104°19'23", in NW¼NW¼ sec.18, T.17 S., R.27 E., Eddy County, Hydrologic Unit 13060007, on left bank 250 ft (76 m) upstream from bridge on State Highway 83, 4.3 mi (6.9 km) east of Artesia, 7.0 mi (11.3 km) upstream from Rio Penasco, 17 mi (27.4 km) upstream from McMillan Dam, and at mile 503.9 (810.8 km). Prior to Apr. 3, 1981, at site 250 ft (76 m) downstream.

DRAINAGE AREA.--15,300 mi^2 (39,630 km^2), approximately (contributing area).

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--September 1905 to June 1909, August 1909 to current year. Monthly discharge only for some periods, published in WSP 1312 and 1712. Records for Aug. 22-31, 1934, and October 1936 to April 1937, published in WSP 763 and 828, respectively are not reliable and should not be used. Prior to February 1936, published as "near Dayton."

REVISED RECORDS.--WSP 1312 and 1512: 1913, 1915, 1917-18(M), 1920, 1923, 1931-36. WSP 1712: 1906(M), 1908-11(M), 1919, 1921-23(M), 1929, 1931-32(M), 1935-36(M), 1937, 1939(M), 1941(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 3,291.92 ft (1,003.376 m) National Geodetic Vertical Datum of 1929. See WSP 1923 or 2123 for history of changes prior to Apr. 5, 1941. Apr. 5, 1941 to Apr. 2, 1981, water-stage recorder at site 250 ft (76 m) downstream at same datum.

REMARKS.--Water-discharge records fair. Flow regulated by Santa Rosa Lake (station 08382810) since Arpil 1980, by Lake Sumner (station 08384000) since August 1937, and by Two Rivers Reservoir (station 08390600) since July 1963. Diversions and ground-water withdrawals for irrigation of about 154,000 acres (620 km^2), 1959 determination, above station.

AVERAGE DISCHARGE.--46 years, 244 ft^3/s (6.910 m^3/s), 176,800 acre-ft/yr (218 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge probably occurred May 30, 1937, when a discharge of 51,500 ft^3/s (1,460 m^3/s) was measured by slope-area method at a point 15 mi (24.1 km) upstream, gage height, 14.7 ft (4.48 m), site and datum then in use; no flow at times in 1934, 1946-47, 1953-54, 1957, 1964-65.

EXTREMES OUTSIDE PERIOD OF RECORD.--Greatest flood since at least 1893 occurred Oct. 2, 1904, discharge not determined; the peak inflow to Lake McMillan, which includes Rio Penasco and Fourmile Draw, was estimated at 82,000 ft^3/s (2,320 m^3/s). The second highest flood occurred July 25, 1905, discharge below Rio Penasco, 50,300 ft^3/s (1,420 m^3/s), based on gain in storage and spill from Lake McMillan. The floods in August 1893and October 1904 damaged McMillan Dam and washed out Avalon Dam.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,070 ft^3/s (58.6 m^3/s) at 2230 hours Sept. 15, gage height, 10.15 ft (3.094 m) from floodmarks, no other peak above base of 2,000 ft^3/s (57 m^3/s); minimum, 1.3 ft^3/s (0.037 m^3/s) Sept. 2.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	56	96	59	53	58	49	23	885	24	70	25	2.1
2	53	95	62	53	57	49	24	845	19	55	30	1.3
3	87	88	62	53	56	48	24	754	16	154	37	4.9
4	57	83	62	53	56	42	25	517	13	483	57	129
5	95	77	62	52	56	40	25	246	11	537	87	564
6	117	92	62	51	56	39	24	177	10	620	56	654
7	109	104	62	51	56	39	23	143	11	760	34	684
8	269	93	62	51	56	40	24	117	8.6	740	32	713
9	182	83	61	51	55	41	24	106	7.3	800	22	744
10	164	71	60	50	56	40	22	98	7.7	930	18	750
11	168	67	60	50	59	38	26	81	6.4	920	15	758
12	153	64	60	50	59	36	27	66	11	880	8.0	755
13	127	64	60	50	59	39	29	58	7.5	1100	6.0	769
14	107	64	60	50	58	41	28	50	5.5	900	6.0	842
15	95	65	60	115	58	39	26	51	5.3	911	5.0	973
16	88	65	60	120	59	35	550	50	5.7	900	6.0	1240
17	78	64	59	120	59	35	662	48	13	878	6.5	966
18	73	60	58	110	55	36	715	38	8.6	849	5.5	710
19	71	55	58	62	51	35	752	35	9.2	798	6.0	324
20	69	58	58	64	49	34	805	32	8.1	549	4.0	454
21	67	58	57	69	49	32	832	26	8.3	190	4.5	307
22	67	59	56	77	49	31	850	22	8.1	146	3.5	256
23	72	56	55	89	48	32	875	19	14	106	3.5	203
24	80	54	55	86	48	29	965	20	11	87	4.0	181
25	86	53	54	78	49	26	888	27	8.6	92	4.0	166
26	97	53	54	74	49	25	902	25	6.9	55	7.0	165
27	101	50	54	69	49	25	818	27	8.0	38	30	148
28	94	52	54	65	49	26	812	32	6.9	39	35	128
29	102	54	53	61	---	24	815	36	7.8	31	20	99
30	103	56	53	60	---	21	770	29	18	25	10	82
31	93	---	53	58	---	20	---	25	---	22	7.0	---
TOTAL	3180	2053	1805	2095	1518	1086	12345	4685	305.5	14665	594.5	13772.3
MEAN	103	68.4	58.2	67.6	54.2	35.0	412	151	10.2	473	19.2	459
MAX	269	104	62	120	59	49	965	885	24	1100	87	1240
MIN	53	50	53	50	48	20	22	19	5.3	22	3.5	1.3
AC-FT	6310	4070	3580	4160	3010	2150	24490	9290	606	29090	1180	27320

CAL YR 1981 TOTAL 33069.8 MEAN 90.6 MAX 788 MIN 3.0 AC-FT 65590
WTR YR 1982 TOTAL 58104.3 MEAN 159 MAX 1240 MIN 1.3 AC-FT 115200

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1937 to current year.

PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: July 1937 to current year.
WATER TEMPERATURES: April 1949 to current year.
SUSPENDED SEDIMENT DISCHARGE: January 1949 to current year.

REMARKS.--Continuous water-temperature and specific conductance recorder since July 1981.

EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily, 28,800 micromhos June 24, 1977; minimum daily, 111 micromhos Aug. 31, 1982.
WATER TEMPERATURES: Maximum, 36.0°C July 27, 1966, July 25, 1969; minimum, 0.0°C on many days during winter months of most years.
SEDIMENT CONCENTRATIONS: Maximum daily, 21,300 mg/L Aug. 1, 1962; minimum daily, 0 mg/L on several days in December, 1982
SEDIMENT LOADS: Maximum daily, 183,000 tons (166,000 tonnes) Sept. 26, 1955; minimum daily, 0 tons (0 tonnes) on many days during July 1953, July and August 1954, July 1957, July to October 1964, December, 1982.

EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily, 25,200 micromhos Aug. 29; minimum daily, 111 micromhos Aug. 31.
WATER TEMPERATURES: Maximum, 35.5°C Sept. 1; minimum, 2.0°C Jan. 15.
SEDIMENT CONCENTRATIONS: Maximum daily, 6,350 mg/L Apr. 17; minimum daily, 0 mg/L on several days in December.
SEDIMENT LOADS: Maximum daily, 11,300 tons (10,300 tonnes) Apr. 17; minimum daily, 0 ton (0 tonne) on several days in December.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (00061)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE, AIR (DEG C) (00020)	TEMPER-ATURE (DEG C) (00010)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L) (00340)	HARD-NESS (MG/L AS CACO3) (00900)
DEC											
02...	1300	60	10000	10300	8.2	7.7	13.0	8.5	--	<94	2653
APR											
01...	1100	22	14500	13400	8.0	7.1	21.0	14.0	8.3	250	3255
16...	1600	--	10400	--	--	--	--	--	--	--	--
26...	1600	866	2870	2870	8.0	7.5	33.0	16.0	8.2	53	1599
AUG											
31...	1215	7.3	--	7500	8.2	8.3	28.0	28.0	--	32	1957

DATE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE ITFLD (MG/L AS HCO3) (99440)	CAR-BONATE ITFLD (MG/L AS CO3) (99445)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)
DEC											
02...	2483	650	250	1300	11	10	--	--	2100	2500	.8
APR											
01...	3105	710	360	2200	17	18	180	.00	2600	4000	.9
16...	--	--	--	--	--	--	--	--	--	--	--
26...	1499	520	73	150	1.7	4.2	200	.00	1500	190	.7
AUG											
31...	1869	520	160	1100	11	12	--	--	1800	1800	.7

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	PHOS-PHORUS, TOTAL (MG/L AS P) (00665)	PHOS-PHORUS, ORTHO, DIS-SOLVED (MG/L AS P) (00671)	CARBON, ORGANIC TOTAL (MG/L AS C) (00680)
DEC										
02...	9.8	6930	1.1	1.1	.320	.98	2.4	.130	.060	3.9
APR										
01...	8.0	9990	<.10	.15	.300	.21	--	.280	.090	8.8
16...	--	--	--	--	--	--	--	--	--	--
26...	9.9	2510	.13	.16	.120	2.6	2.8	--	.030	13
AUG										
31...	10	5460	.20	.12	.130	1.1	1.4	.090	.050	5.3

TEMPERATURE WATER (DEG.° C), RECORDER MAXIMUM, MINIMUM, AND MEAN, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		FEBRUARY			MARCH			APRIL			MAY	
1							17.5	14.5	16.5			
2							20.5	11.5	16.0			
3							17.5	10.0	14.0			
4							22.5	11.5	16.5			
5							22.0	11.0	16.5			
6							18.5	11.5	15.0			
7							18.5	12.5	15.5			
8							21.5	11.5	16.5			
9							20.0	13.5	17.0			
10							22.0	13.5	18.0			
11							23.5	13.0	18.5			
12							24.5	16.0	20.5			
13							26.0	16.5	21.5			
14							22.5	17.0	20.0			
15							24.0	13.5	18.5			
16							20.0	15.5	18.0			
17							17.5	15.5	16.5			
18							17.5	10.0	15.5			
19							16.5	15.0	16.0			
20							16.5	15.5	16.0			
21							15.5	14.0	14.5			
22							14.0	12.5	13.5			
23							12.5	11.5	12.0			
24							12.0	11.5	11.5			
25							14.0	12.0	12.5			
26							14.5	14.0	14.0			
27							---	---	---			
28							---	---	---			
29							---	---	---			
30							---	---	---			
31							---	---	---			
MONTH							26.0	10.0	16.0			

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		JUNE			JULY			AUGUST			SEPTEMBER	
1							---	---	---	35.5	24.0	29.0
2							---	---	---	32.0	24.5	27.0
3							---	---	---	31.5	22.0	24.5
4							---	---	---	---	---	---
5							---	---	---	---	---	---
6							---	---	---	---	---	---
7							---	---	---	---	---	---
8							---	---	---	---	---	---
9							---	---	---	---	---	---
10							---	---	---	---	---	---
11							---	---	---	---	---	---
12							---	---	---	---	---	---
13							---	---	---	---	---	---
14							---	---	---	---	---	---
15							---	---	---	---	---	---
16							---	---	---	---	---	---
17							---	---	---	---	---	---
18							---	---	---	---	---	---
19							---	---	---	---	---	---
20							---	---	---	---	---	---
21							---	---	---	---	---	---
22							---	---	---	---	---	---
23							---	---	---	---	---	---
24							---	---	---	---	---	---
25							---	---	---	---	---	---
26							---	---	---	---	---	---
27							---	---	---	---	---	---
28							---	---	---	---	---	---
29							---	---	---	---	---	---
30							---	---	---	---	---	---
31							33.5	28.0	31.0	---	---	---
MONTH							33.5	28.0	31.0	35.5	22.0	27.0

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)
	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
1	22	3.3	31	8.0	6	.96	5	.72	4	.63	7	.93
2	22	3.1	27	6.9	21	3.5	7	1.0	3	.46	5	.66
3	39	9.2	43	10	12	2.0	9	1.3	3	.45	6	.78
4	58	8.9	42	9.4	7	1.2	6	.86	2	.30	13	1.5
5	63	16	38	7.9	3	.50	7	.98	2	.30	4	.43
6	65	21	31	7.7	1	.17	4	.55	8	1.2	4	.42
7	68	20	30	8.4	1	.17	6	.83	5	.76	4	.42
8	470	341	32	8.0	0	.00	6	.83	4	.60	7	.76
9	417	205	23	5.2	0	.00	9	1.2	2	.30	6	.66
10	1050	465	27	5.2	1	.16	7	.95	3	.45	7	.76
11	1150	522	26	4.7	1	.16	9	1.2	5	.80	12	1.2
12	2020	834	30	5.2	3	.49	7	.95	6	.96	13	1.3
13	1560	535	18	3.1	2	.32	7	.95	4	.64	19	2.0
14	453	131	15	2.6	0	.00	6	.81	5	.78	18	2.0
15	254	65	15	2.6	0	.00	8	2.5	5	.78	22	2.3
16	176	42	26	4.6	0	.00	7	2.3	6	.96	32	3.0
17	76	16	20	3.5	1	.16	8	2.6	9	1.4	14	1.3
18	61	12	21	3.4	0	.00	9	2.7	5	.74	14	1.4
19	48	9.2	24	3.6	1	.16	11	1.8	4	.55	21	2.0
20	53	9.9	27	4.2	0	.00	10	1.7	5	.66	18	1.7
21	53	9.6	14	2.2	2	.31	9	1.7	3	.40	14	1.2
22	50	9.0	12	1.9	4	.60	12	2.5	4	.53	21	1.8
23	47	9.1	10	1.5	5	.74	13	3.1	8	1.0	24	2.1
24	49	11	13	1.9	5	.74	9	2.1	5	.65	13	1.0
25	66	15	9	1.3	9	1.3	8	1.7	5	.66	12	.84
26	92	24	10	1.4	7	1.0	8	1.6	4	.53	11	.74
27	75	20	9	1.2	3	.44	6	1.1	2	.26	11	.74
28	75	19	10	1.4	7	1.0	7	1.2	5	.66	13	.91
29	95	26	8	1.2	5	.72	7	1.2	---	---	31	2.0
30	96	27	8	1.2	2	.29	10	1.6	---	---	28	1.6
31	38	9.5	---	---	1	.14	7	1.1	---	---	16	.86
TOTAL	---	3447.8	---	129.4	---	17.23	---	45.63	---	18.41	---	39.31

DAY	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)	MEAN CONCENTRATION (MG/L)	LOADS (T/DAY)
	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
1	19	1.2	2320	5540	37	2.4	22	4.2	48	3.2	22	.12
2	25	1.6	2140	4880	36	1.8	39	5.8	70	5.7	17	.06
3	24	1.6	2060	4190	33	1.4	363	368	72	7.2	15	.20
4	40	2.7	1390	1940	58	2.0	5260	6860	59	9.1	664	693
5	26	1.8	800	531	53	1.6	4550	6600	79	19	4280	6520
6	26	1.7	550	263	46	1.2	3750	6280	54	8.2	3630	6410
7	60	3.7	454	175	31	.92	3220	6610	34	3.1	2910	5370
8	25	1.6	279	88	31	.72	2650	5290	142	12	3330	6410
9	44	2.9	234	67	22	.43	2150	4640	38	2.3	4710	9460
10	28	1.7	155	41	39	.81	2110	5300	27	1.3	2820	5710
11	22	1.5	82	18	53	.92	2660	6610	36	1.5	2600	5320
12	18	1.3	48	8.6	38	1.1	3770	8960	31	.67	2580	5260
13	22	1.7	39	6.1	21	.43	2220	6590	44	.71	2650	5500
14	25	1.9	34	4.6	21	.31	3790	9210	54	.87	2790	6340
15	23	1.6	40	5.5	22	.31	3900	9590	35	.47	2400	6310
16	5800	9780	38	5.1	23	.35	3310	8040	41	.66	2450	8200
17	6350	11300	35	4.5	27	.95	3090	7330	34	.60	2650	6910
18	4270	8240	37	3.8	38	.88	2500	5730	41	.61	2210	4240
19	3460	7030	29	2.7	26	.65	1650	3560	36	.58	1100	962
20	3240	7040	33	2.9	13	.28	1350	2000	37	.40	1220	1500
21	3080	6920	31	2.2	14	.31	838	430	43	.52	871	722
22	2700	6200	30	1.8	22	.48	662	261	66	.62	1430	988
23	2410	5690	36	1.8	16	.60	480	137	63	.60	1640	899
24	2130	5550	37	2.0	17	.50	460	108	53	.57	1020	498
25	2470	5920	44	3.2	92	2.1	197	49	56	.60	842	377
26	2410	5610	34	2.3	24	.45	104	15	44	.83	835	372
27	2300	5080	30	2.2	22	.48	61	6.3	46	3.7	501	200
28	2440	5350	42	3.6	20	.37	64	6.7	59	5.6	241	83
29	1800	3960	37	3.6	10	.21	38	3.2	55	3.0	140	37
30	1730	3600	31	2.4	13	.63	46	3.1	30	.81	66	15
31	---	---	34	2.3	---	---	44	2.6	34	.64	---	---
TOTAL	---	97298.5	---	17804.2	---	25.59	---	110599.9	---	95.66	---	95306.38

TOTAL LOAD FOR YEAR: 324828.01 TONS.

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8650	6130	9810	9900	10200	11000	13700	2780	10600	11200	8220	7430
2	8580	6400	10100	10000	10300	11100	14200	2830	11200	11100	8510	8100
3	8890	6610	10100	9960	10200	11200	14300	2820	11900	9080	7980	9270
4	5750	6580	9350	10100	10300	11300	14000	3070	12800	3720	6550	9690
5	5780	7030	9270	10000	10200	11300	13800	3190	15600	3010	3940	3080
6	9220	6350	8840	10100	10200	11300	-----	3510	15200	2410	4390	2020
7	9200	6320	9180	10200	10200	11100	-----	3710	15400	1720	4650	1690
8	5300	6190	9170	10100	10100	11200	-----	4090	16900	1600	5780	1550
9	5260	6720	9440	10100	10100	11100	-----	4370	16400	1370	6930	1520
10	5230	7150	9870	10200	9920	11100	-----	4600	15800	1380	7030	1350
11	5210	7550	9850	10400	9870	11500	-----	4790	16700	1310	7950	1270
12	4070	8000	9890	10100	10600	11700	-----	5190	17300	1230	9500	1120
13	4060	8350	9900	10100	10200	11800	-----	5340	18700	1180	9810	1090
14	5360	8390	9940	9820	10100	11500	-----	5930	21100	1400	9880	1030
15	6070	8700	9700	9830	10200	11600	-----	6370	20600	1170	10500	350
16	6690	8880	9750	9850	9940	11500	----	6870	18700	1120	12400	920
17	7090	8980	9620	11200	9690	12100	----	7760	20600	1100	12700	970
18	7080	8250	10000	11200	10000	12100	----	7630	22200	1100	15600	930
19	7720	9080	10000	9240	10100	11800	----	8140	17600	1110	15900	1260
20	8030	9070	10100	9310	10100	12000	----	8910	16400	1230	16700	1380
21	8290	9280	10100	10900	10300	12200	----	10700	17900	1560	16400	1430
22	8320	9220	10100	10500	10300	12100	----	10700	17200	1570	16000	2000
23	8330	9510	10200	9750	10800	12000	----	10200	17400	1770	17000	1820
24	8400	9480	10200	8340	10700	12700	----	10200	17600	1770	16400	1940
25	7680	9700	10100	8310	10800	12800	----	13000	15000	2080	16700	2230
26	7140	9670	10100	8730	10800	12900	----	10400	14000	2760	18200	2150
27	6430	9910	10400	9120	11000	12900	2840	10300	14100	3430	19300	2730
28	6440	9900	10400	9150	10900	13100	2820	10100	14800	4170	18700	2900
29	5820	9850	10300	9620	---	12900	2800	9930	18300	4480	25200	3120
30	5800	9670	10400	10000	---	13400	2830	9680	7430	5210	7460	3530
31	6090	---	10100	10200	---	13800	---	10700	---	7980	7180	---
MEAN	6840	8230	9880	9880	10300	11900	7780	7030	16200	3070	11700	2660

WTR YR 1982 MEAN 8790 MAX 25200 MIN 350

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), RECORDER MAXIMUM, MINIMUM, AND MEAN,
WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		FEBRUARY			MARCH			APRIL			MAY	
1							14800	13000	14000			
2							14800	12700	13400			
3							14400	12200	13300			
4							14400	12500	13400			
5							14300	12200	13200			
6							13100	12100	12500			
7							13400	12100	12700			
8							14000	11800	12700			
9							13500	11700	12400			
10							12700	10800	11700			
11							12100	10400	11200			
12							11400	10000	10800			
13							10700	2600	9710			
14							10100	2100	9400			
15							10700	2500	8920			
16							9000	4370	5870			
17							4310	3790	4020			
18							3820	2850	3560			
19							2940	2700	2810			
20							2780	2690	2730			
21							2720	2580	2660			
22							2640	2560	2590			
23							2580	2550	2560			
24							2710	2540	2610			
25							2790	2570	2680			
26							2700	2580	2620			
27							---	---	---			
28							---	---	---			
29							---	---	---			
30							---	---	---			
31							---	---	---			
MONTH							14800	2100	8230			

WATER-QUALITY RECORDS

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.° C), RECORDER MAXIMUM, MINIMUM, AND MEAN, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		JUNE			JULY			AUGUST			SEPTEMBER	
1							---	---	---	7480	6880	7210
2							---	---	---	8530	7230	7930
3							---	---	---	9630	7430	8920
4							---	---	---	---	---	---
5							---	---	---	---	---	---
6							---	---	---	---	---	---
7							---	---	---	---	---	---
8							---	---	---	---	---	---
9							---	---	---	---	---	---
10							---	---	---	---	---	---
11							---	---	---	---	---	---
12							---	---	---	---	---	---
13							---	---	---	---	---	---
14							---	---	---	---	---	---
15							---	---	---	---	---	---
16							---	---	---	---	---	---
17							---	---	---	---	---	---
18							---	---	---	---	---	---
19							---	---	---	---	---	---
20							---	---	---	---	---	---
21							---	---	---	---	---	---
22							---	---	---	---	---	---
23							---	---	---	---	---	---
24							---	---	---	---	---	---
25							---	---	---	---	---	---
26							---	---	---	---	---	---
27							---	---	---	---	---	---
28							---	---	---	---	---	---
29							---	---	---	---	---	---
30							---	---	---	---	---	---
31							7180	6980	7120	---	---	---
MONTH							7180	6980	7120	9630	6880	8020

TEMPERATURE WATER (DEG.° C), WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21.0	11.5	11.0	10.5	5.5	9.0	17.0	17.0	27.5	29.0	29.0	33.0
2	20.5	15.5	10.5	10.0	6.0	12.0	18.5	17.0	27.0	24.5	25.0	25.0
3	23.0	15.0	11.0	11.0	5.0	15.5	17.0	17.5	24.0	31.0	31.0	29.5
4	23.0	14.0	9.0	8.5	5.5	18.0	19.5	20.0	25.5	25.5	27.0	28.0
5	23.5	12.0	10.0	6.0	4.0	10.0	20.0	18.0	24.0	26.0	30.5	30.5
6	21.5	13.0	8.0	11.0	3.0	9.0	13.0	22.0	25.0	25.0	32.0	25.0
7	22.0	14.0	7.5	7.5	6.0	7.0	---	19.0	28.0	29.0	29.5	24.0
8	20.0	13.5	8.0	5.0	7.0	16.0	---	24.5	29.0	25.0	25.0	25.0
9	19.0	15.0	11.5	5.5	7.5	14.0	---	24.5	22.0	25.5	30.0	24.0
10	18.0	11.5	9.0	7.0	6.0	15.0	---	20.0	28.0	27.0	25.0	24.0
11	19.0	10.5	9.5	3.0	6.0	21.0	---	20.0	31.0	27.5	29.0	23.0
12	19.5	10.0	10.5	5.0	8.0	17.0	---	21.0	24.0	26.0	31.0	23.5
13	18.0	12.5	12.0	3.0	10.0	16.0	---	21.5	22.0	25.0	29.0	23.0
14	24.0	12.0	9.5	3.0	11.0	18.0	---	22.5	29.0	26.5	29.0	23.5
15	20.5	12.0	10.5	2.0	15.5	17.0	---	24.5	30.0	26.0	27.5	22.5
16	25.0	15.0	11.0	3.0	12.0	20.0	---	20.5	25.0	27.5	31.5	22.5
17	24.0	14.5	12.0	5.0	14.0	17.0	---	27.0	26.5	26.0	29.0	21.5
18	23.5	15.0	9.5	4.0	15.5	17.5	---	24.0	27.0	26.0	23.5	21.5
19	16.0	13.0	9.0	5.0	15.0	21.0	---	27.0	26.0	28.0	26.5	21.0
20	20.0	14.0	9.0	7.0	14.5	19.0	---	27.5	23.0	30.0	28.0	23.0
21	17.0	11.0	8.0	9.0	11.5	12.0	---	26.5	28.0	30.5	28.5	20.0
22	18.0	9.5	9.0	9.0	11.0	18.0	---	25.0	30.0	28.0	27.0	21.0
23	16.0	15.0	11.5	7.0	18.0	20.0	---	21.0	29.0	27.0	30.0	22.5
24	14.5	11.0	11.0	7.0	14.0	15.0	---	24.0	27.0	27.0	28.5	24.0
25	16.0	11.0	10.0	7.5	11.0	14.0	---	26.0	27.5	25.0	30.0	21.0
26	17.0	11.5	9.5	7.5	11.5	12.0	---	27.0	28.0	31.5	24.0	25.0
27	17.0	14.0	9.0	12.0	9.0	13.5	18.0	27.5	24.5	31.5	24.0	22.5
28	18.5	12.0	8.0	8.5	9.5	13.0	20.0	28.0	33.5	30.5	32.0	24.5
29	19.0	12.0	9.0	12.0	---	18.0	19.5	27.0	25.0	27.0	28.5	21.0
30	20.0	10.0	10.0	9.0	---	17.0	18.0	23.5	28.0	31.0	32.0	22.0
31	14.0	---	10.0	6.0	---	19.5	---	28.0	---	28.0	31.0	---
MEAN	19.5	12.5	10.0	7.0	9.5	15.5	18.0	23.0	27.0	27.5	28.5	24.0

WTR YR 1982 MEAN 18.5 MAX 33.5 MIN 2.0

TRACE ELEMENT ANALYSES, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DATE	TIME	ARSENIC TOTAL (UG/L AS AS) (01002)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD) (01027)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR) (01034)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU) (01042)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)
DEC										
02...	1300	2	1	560	1	<1	20	20	5	3
APR										
01...	1100	--	--	830	--	--	--	--	--	--
26...	1600	8	2	120	<1	<1	40	10	40	3
AUG										
31...	1215	--	--	580	--	--	--	--	--	--

DATE	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB) (01051)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG) (71900)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	SELE-NIUM, TOTAL (UG/L AS SE) (01147)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN) (01092)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
DEC									
02...	130	3	2	.1	.2	3	2	30	20
APR									
01...	80	--	--	--	--	--	--	--	--
26...	540	19	10	.1	.1	3	1	110	40
AUG									
31...	50	--	--	--	--	--	--	--	--

RADIOCHEMICAL ANALYSES, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DATE	TIME	GROSS ALPHA, DIS-SOLVED (UG/L AS UNAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS UNAT) (80040)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/ YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/ YT-90) (80060)	RADIUM 226, DIS-SOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DIS-SOLVED (UG/L AS U) (22703)
APR									
26...	1600	53	110	<25	80	<24	77	.07	4.7

PESTICIDE ANALYSES, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DATE	TIME	PCB, TOTAL (UG/L) (39516)	ALDRIN, TOTAL (UG/L) (39330)	CHLOR-DANE, TOTAL (UG/L) (39350)	DDD, TOTAL (UG/L) (39360)	DDE, TOTAL (UG/L) (39365)	DDT, TOTAL (UG/L) (39370)	DI-AZINON, TOTAL (UG/L) (39570)
AUG								
31...	1215	<.10	<.01	<.10	<.01	<.01	<.01	.01

DATE	DI-ELDRIN TOTAL (UG/L) (39380)	ENDO-SULFAN, TOTAL (UG/L) (39388)	ENDRIN, TOTAL (UG/L) (39390)	ETHION, TOTAL (UG/L) (39398)	HEPTA-CHLOR, TOTAL (UG/L) (39410)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L) (39420)	LINDANE TOTAL (UG/L) (39340)	MALA-THION, TOTAL (UG/L) (39530)	METH-OXY-CHLOR, TOTAL (UG/L) (39480)
AUG									
31...	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01

DATE	METHYL PARA-THION, TOTAL (UG/L) (39600)	METHYL TRI-THION, TOTAL (UG/L) (39790)	PARA-THION, TOTAL (UG/L) (39540)	TOX-APHENE, TOTAL (UG/L) (39400)	TOTAL TRI-THION (UG/L) (39786)	PER-THANE TOTAL (UG/L) (39034)	THA-LENES, POLY-CHLOR. TOTAL (UG/L) (39250)	MIREX, TOTAL (UG/L) (39755)
AUG								
31...	<.01	<.01	<.01	<1	<.01	<.10	<.10	<.01

RIO GRANDE BASIN

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

MICROBIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

DATE	COLI-FORM, FECAL, 0.7 UMMF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
DEC		
02...	130	280
APR		
01...	73	390
16...	--	500
26...	340	--
AUG		
31...	K35	K110

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982

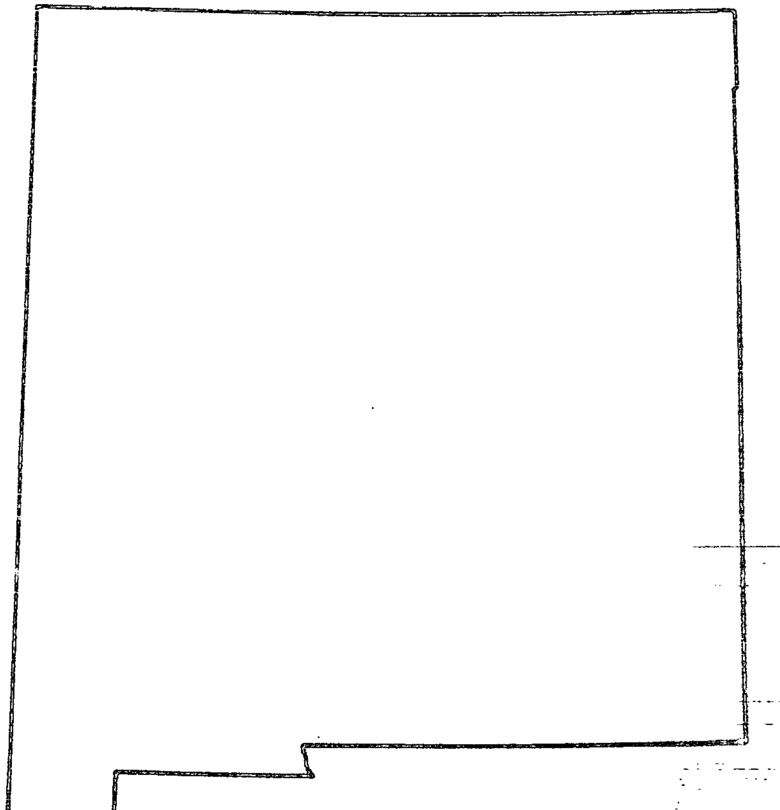
DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (00061)	TEMPER-ATURE (DEG C) (00010)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)
OCT							
10...	1049	163	18.0	1120	493	--	--
12...	1007	157	19.5	1950	827	57	75
APR							
01...	1200	22	15.5	17	1.0	--	--
16...	1022	648	18.0	6690	11700	46	65
18...	1720	728	17.0	3860	7590	48	60
22...	0836	860	12.0	2720	6320	40	53
24...	1105	980	12.5	2090	5530	--	--
26...	1600	866	16.0	2520	5890	31	39
30...	1738	775	18.0	1880	3930	--	--
MAY							
02...	1543	830	17.0	2090	4680	30	38
04...	1737	600	20.0	1170	1900	36	56
08...	1737	117	24.5	245	77	--	--
JUL							
04...	0930	13	25.5	5370	188	44	58
13...	1033	7.5	25.0	2220	45	38	51
18...	1104	8.6	26.0	2520	59	22	32
AUG							
08...	0915	31	25.0	294	25	--	--
SEP							
07...	1045	695	24.0	2760	5180	--	--
08...	1700	735	25.0	2990	5930	29	38
22...	1831	225	21.0	1730	1050	--	--
25...	0950	169	21.0	854	390	--	--

DATE	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)	SED. SUSP. SIEVE DIAM. % FINER THAN .125 MM (70332)	SED. SUSP. SIEVE DIAM. % FINER THAN .250 MM (70333)
OCT							
10...	--	--	--	--	99	--	--
12...	95	--	--	--	99	100	--
APR							
01...	--	--	--	--	70	--	--
16...	87	--	--	--	97	100	--
18...	89	--	--	--	99	100	--
22...	80	--	--	--	98	100	--
24...	--	--	--	--	96	--	--
26...	62	88	98	100	--	--	--
30...	--	--	--	--	94	--	--
MAY							
02...	60	88	99	100	--	--	--
04...	77	--	--	--	96	100	--
08...	--	--	--	--	98	--	--
JUL							
04...	85	--	--	--	95	99	100
13...	80	--	--	--	99	100	--
18...	50	86	100	--	--	--	--
AUG							
08...	--	--	--	--	47	--	--
SEP							
07...	--	--	--	--	95	--	--
08...	59	91	100	--	--	--	--
22...	--	--	--	--	100	--	--
25...	--	--	--	--	100	--	--

Lepp

Water Resources Data New Mexico

Water Year 1981



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NM-81-1

Prepared in cooperation with the State of New Mexico and with other agencies

08396500 PECOS RIVER NEAR ARTESIA, NM
(Surveillance program station)

LOCATION.--Lat 32°50'27", long 104°19'23", in NW¼NW¼ sec.18, T.17 S., R.27 E., Eddy County, Hydrologic Unit 13060007, on left bank 250 ft (76 m) upstream from bridge on State Highway 83, 4.3 mi (6.9 km) east of Artesia, 7.0 mi (11.3 km) upstream from Rio Penasco, 17 mi (27.4 km) upstream from McMillan Dam, and at mile 503.9 (810.8 km). Prior to Apr. 3, 1981, at site 250 ft (76 m) downstream.
DRAINAGE AREA.--15,300 mi^2 (39,630 km^2), approximately (contributing area).

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--September 1905 to June 1909, August 1909 to current year. Monthly discharge only for some periods, published in WSP 1312 and 1712. Records for Aug. 22-31, 1934, and October 1936 to April 1937, published in WSP 763 and 828, respectively are not reliable and should not be used. Prior to February 1936, published as "near Dayton."
REVISED RECORDS.--WSP 1312 and 1512: 1913, 1915, 1917-18(M), 1920, 1923, 1931-36. WSP 1712: 1906(M), 1908-11(M), 1919, 1921-23(M), 1929, 1931-32(M), 1935-36(M), 1937, 1939(M), 1941(M). See also PERIOD OF RECORD.
GAGE.--Water-stage recorder. Datum of gage is 3,291.92 ft (1,003.376 m) National Geodetic Vertical Datum of 1929. See WSP 1923 or 2123 for history of changes prior to Apr. 5, 1941. Apr. 5, 1941 to Apr. 2, 1981, water-stage recorder at site 250 ft (76 m) downstream at same datum.
REMARKS.--Water-discharge records fair. Flow regulated by Santa Rosa Lake (station 08382810) since Arpil 1980, by Lake Sumner (station 08384000) since August 1937, and by Two Rivers Reservoir (station 08390600) since July 1963. Diversions and ground-water withdrawals for irrigation of about 154,000 acres (620 km^2), 1959 determination, above station.
AVERAGE DISCHARGE.--45 years, 246 ft^3/s (6.967 m^3/s), 178,200 acre-ft/yr (220 hm^3/yr).
EXTREMES FOR PERIOD OF RECORD.--Maximum discharge probably occurred May 30, 1937, when a discharge of 51,500 ft^3/s (1,460 m^3/s) was measured by slope-area method at a point 15 mi (24.1 km) upstream, gage height, 14.7 ft (4.48 m), site and datum then in use; no flow at times in 1934, 1946-47, 1953-54, 1957, 1964-65.
EXTREMES OUTSIDE PERIOD OF RECORD.--Greatest flood since at least 1893 occurred Oct. 2, 1904, discharge not determined; the peak inflow to Lake McMillan, which includes Rio Penasco and Fourmile Draw, was estimated at 82,000 ft^3/s (2,320 m^3/s). The second highest flood occurred July 25, 1905, discharge below Rio Penasco, 50,300 ft^3/s (1,420 m^3/s), based on gain in storage and spill from Lake McMillan. The floods in August 1893and October 1904 damaged McMillan Dam and washed out Avalon Dam.
EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,080 ft^3/s (30.6 m^3/s) Aug. 13, gage height, 7.21 ft (2.198 m), no peak above base of 2,000 ft^3/s (57 m^3/s); minimum, 2.8 ft^3/s (0.079 m^3/s) July 27.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	149	77	66	42	45	18	9.3	13	712	36	38	26
2	132	81	65	39	43	19	12	11	733	75	18	79
3	124	78	66	41	43	25	13	14	740	49	13	60
[illegible]	103	82	64	42	44	31	10	107	742	113	13	44
[illegible]	92	81	62	43	45	36	9.4	82	755	71	20	57
6	78	72	62	43	47	33	11	48	788	46	18	382
7	69	66	59	42	46	35	15	358	732	27	21	477
8	65	64	55	44	47	30	15	192	718	19	26	446
9	62	62	49	45	47	19	12	114	685	14	153	279
10	64	57	49	45	45	30	17	73	597	158	168	202
11	62	54	49	45	44	24	18	45	528	230	112	165
12	59	51	49	44	44	18	12	27	441	169	231	144
13	60	48	49	44	42	16	14	17	408	175	744	124
14	58	45	49	43	38	23	20	12	169	94	648	111
15	53	44	49	43	31	30	17	11	96	51	427	99
16	47	50	48	43	36	30	22	10	62	34	286	84
17	46	57	48	46	27	30	20	15	47	23	302	79
18	46	59	49	48	28	25	19	21	33	24	388	73
19	47	65	49	50	33	21	19	20	26	18	272	76
20	47	65	48	51	33	19	26	14	23	14	265	73
21	48	64	48	52	34	18	29	14	24	15	261	66
22	48	62	48	52	39	20	23	13	29	8.8	185	69
23	48	59	48	52	39	21	20	12	24	10	136	69
24	47	57	48	52	39	16	24	7.8	20	6,7	107	68
25	52	62	47	53	37	11	31	9.3	15	4.0	71	68
26	62	65	47	52	34	14	18	10	61	4.1	60	62
27	64	65	46	51	31	14	16	7.8	99	3,0	49	58
28	59	66	45	48	27	14	25	6.7	56	4.9	38	56
29	59	67	45	47	---	12	19	6.0	36	155	35	63
30	66	67	45	46	---	11	15	226	33	139	31	64
31	74	---	43	46	---	10	---	602	---	77	29	---
TOTAL	2090	1892	1594	1434	1088	673	530.7	2118.6	9432	1867,5	5165	3723
MEAN	67.4	63.1	51.4	46.3	38.9	21.7	17.7	68.3	314	60.2	167	124
MAX	149	82	66	53	47	36	31	602	788	230	744	477
MIN	46	44	43	39	27	10	9.3	6.0	15	3.0	13	26
AC-FT	4150	3750	3160	2840	2160	1330	1050	4200	18710	3700	10240	7380

CAL YR 1980 TOTAL 59053.5 MEAN 161 MAX 1070 MIN 4.1 AC-FT 117100
WTR YR 1981 TOTAL 31607.8 MEAN 86.6 MAX 788 MIN 3.0 AC-FT 62690

PERIOD OF RECORD.--Water years 1937 to current year.
PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: July 1937 to current year.
WATER TEMPERATURES: April 1949 to current year.
SUSPENDED SEDIMENT DISCHARGE: January 1949 to current year.
REMARKS.--Continuous water-temperature and specific conductance recorder since July 1981.
EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily, 28,800 micromhos June 24, 1977; minimum daily, 464 micromhos Sept. 23, 1974.
WATER TEMPERATURES: Maximum, 36.0°C July 27, 1966, July 25, 1969; minimum, 0.0°C on many days during winter months of most years.
SEDIMENT CONCENTRATIONS: Maximum daily, 21,300 mg/L Aug. 1, 1962; minimum daily, no flow on many days during July 1953, July and August 1954, July 1957, July to October 1964.
SEDIMENT LOADS: Maximum daily, 183,000 tons (166,000 tonnes) Sept. 26, 1955; minimum daily, 0 tons (0 tonnes) on many days during July 1953, July and August 1954, July 1957, July to October 1964.
EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily, 18,800 micromhos Mar. 27; minimum daily, 600 micromhos July 29.
WATER TEMPERATURES: Maximum, 35.5°C July 19, 20, 21, Aug. 2; minimum, 3.0°C Nov. 25, Dec. 22, Jan. 20.
SEDIMENT CONCENTRATIONS: Maximum daily, 13,800 mg/L Aug. 13; minimum daily, 4 mg/L Dec. 17, Feb. 17.
SEDIMENT LOADS: Maximum daily, 29,300 tons (26,600 tonnes) Aug. 13; minimum daily, 0.29 ton (0.26 tonne) Feb. 17.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	STREAM-FLOW, INSTANTANEOUS (CFS) (00061)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	PH (UNITS) (00400)	TEMPERATURE, AIR (DEG C) (00020)	TEMPERATURE (DEG C) (00010)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN DEMAND, CHEMICAL (HIGH LEVEL) (MG/L) (00340)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	HARDNESS NONCARBONATE (MG/L AS CACO3) (95902)
NOV 19...	1100	65	9400	8.0	8.0	7.0	10.9	68	2400	2200	--
JAN 30...	1430	46	9500	8.5	14.0	8.0	11.8	66	2400	2200	--
MAR 19...	1400	30	13600	8.7	26.0	12.0	13.1	99	3500	--	3500
MAY 27...	1225	19	15400	8.0	37.0	29.0	9.9	130	3300	--	3200
JUL 23...	1330	9.3	11200	8.3	40.0	33.0	7.6	180	2500	--	2400
SEP 16...	1400	86	6200	8.5	28.0	25.0	--	230	1700	--	1700

DATE	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY LAB (MG/L AS CACO3) (90410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)
NOV 19...	590	220	1200	11	13	180	1600	2200	.2	13	5950
JAN 30...	580	240	1500	13	11	190	2000	2500	1.2	45	6990
MAR 19...	300	680	2200	16	15	84	2600	3800	.8	1.8	9650
MAY 27...	740	360	2500	19	1.3	120	2700	4300	.7	9.2	10700
JUL 23...	590	240	1600	14	20	83	2100	3000	.7	11	7610
SEP 16...	430	160	780	8.2	8.2	75	1400	1300	.7	8.4	4130

DATE	NITROGEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, ORGANIC TOTAL (MG/L AS N) (00605)	NITROGEN, TOTAL (MG/L AS N) (00600)	PHOSPHORUS, TOTAL (MG/L AS P) (00665)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	BORON, DISSOLVED (UG/L AS B) (01020)	IRON, DISSOLVED (UG/L AS FE) (01046)	CARBON, ORGANIC TOTAL (MG/L AS C) (00680)
NOV 19...	1.1	1.1	.690	1.1	2.9	.080	.070	440	50	5.1
JAN 30...	.53	.54	.490	1.2	2.2	.230	.040	600	70	16
MAR 19...	.00	.00	.220	1.5	1.7	.130	.000	800	70	15
MAY 27...	.02	.00	.100	1.3	1.4	.150	.070	1100	70	11
JUL 23...	<.10	<.10	.190	1.5	1.7	.190	<.010	880	50	7.4
SEP 16...	--	.16	--	--	--	--	<.010	390	70	8.4

WATER-QUALITY RECORDS

TRACE ELEMENT ANALYSES, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	ARSENIC TOTAL (UG/L AS AS) (01002)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD) (01027)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR) (01034)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU) (01042)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)
NOV 19...	1100	1	1	440	3	1	20	0	2	2
MAY 27...	1225	2	2	1100	0	0	3	30	5	1

DATE	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB) (01051)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG) (71900)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	SELE-NIUM, TOTAL (UG/L AS SE) (01147)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN) (01092)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
NOV 19...	50	6	4	.0	.0	2	2	30	40
MAY 27...	70	4	2	.2	.0	2	2	60	20

CHEMICAL ANALYSES OF BOTTOM MATERIAL, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	NITRO-GEN, NO2+NO3 TOT. IN BOT MAT (MG/KG AS N) (00633)	NITRO-GEN,NH4 TOTAL IN BOT. MAT. (MG/KG AS N) (00611)	NITRO-GEN,TOT IN BOT-TOM MA-TERIAL (MG/KG AS N) (00603)	PHOS-PHORUS, TOTAL IN BOT. MAT. (MG/KG AS P) (00668)	ARSENIC TOTAL IN BOT-TOM MA-TERIAL (UG/G AS AS) (01003)	CADMIUM RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CD) (01028)	CHRO-MIUM, RECOV. FM BOT-TOM MA-TERIAL (UG/G) (01029)
MAY 27...	1225	15	4.1	65	170	0	0	1

DATE	COBALT, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CO) (01038)	COPPER, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CU) (01043)	IRON, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS FE) (01170)	LEAD, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS PB) (01052)	MANGA-NESE, RECOV. FM BOT-TOM MA-TERIAL (UG/G) (01053)	MERCURY RECOV. FM BOT-TOM MA-TERIAL (UG/G AS HG) (71921)	ZINC, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS ZN) (01093)
MAY 27...	0	3	430	5	250	.02	1

RADIOCHEMICAL ANALYSES, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/ YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/ YT-90) (80060)	RADIUM 226, DIS-SOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DIS-SOLVED (UG/L AS U) (22703)
MAY 27...	1225	< 270	1.8	< 130	2.9	< 130	2.8	.15	6.9

PESTICIDE ANALYSES, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	2,4,5-T TOTAL (UG/L) (39740)	SILVEX, TOTAL (UG/L) (39760)
MAY 27...	1225	.00	.00

MICROBIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
NOV			
19...	1100	7	380
JAN			
30...	1430	4	32
MAR			
19...	1400	1	260
MAY			
27...	1225	21	10
JUL			
23...	1330	0	18
SEP			
16...	1400	230	140

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (00061)	TEMPER-ATURE (DEG C) (00010)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)
NOV								
19...	1100	65	7.0	57	10	--	--	--
MAR								
19...	1400	30	12.0	61	4.9	--	--	--
31...	1410	10	23.0	99	2.7	--	--	--
MAY								
07...	1012	392	18.0	4990	5280	48	69	97
30...	1536	430	23.0	3750	4350	35	50	84
31...	0812	576	22.0	3800	5910	33	49	82
JUN								
02...	1114	748	23.0	3400	6870	41	55	85
06...	1810	788	24.5	3130	6660	25	35	56
13...	1057	408	26.0	1550	1710	29	42	67
14...	0930	169	25.0	889	406	49	64	83
JUL								
10...	1130	301	23.5	4630	3760	50	66	81
10...	1851	219	28.5	7400	4380	57	77	96
30...	1639	136	30.0	9170	3370	69	82	100
AUG								
14...	1519	629	26.0	9400	16000	52	69	89
15...	1510	369	26.5	6440	6420	60	78	93
SEP								
07...	1838	487	21.0	3520	4630	45	61	84
10...	1419	317	24.0	1860	1590	58	73	94

DATE	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)	SED. SUSP. SIEVE DIAM. % FINER THAN .125 MM (70332)	SED. SUSP. SIEVE DIAM. % FINER THAN .250 MM (70333)	SED. SUSP. SIEVE DIAM. % FINER THAN .500 MM (70334)
NOV							
19...	--	--	--	73	82	96	100
MAR							
19...	--	--	--	85	--	--	--
31...	--	--	--	70	75	96	100
MAY							
07...	100	--	--	--	--	--	--
30...	--	--	--	98	100	--	--
31...	--	--	--	98	100	--	--
JUN							
02...	--	--	--	98	100	--	--
06...	89	100	--	--	--	--	--
13...	--	--	--	89	99	100	--
14...	--	--	--	95	100	--	--
JUL							
10...	93	99	100	--	--	--	--
10...	100	--	--	--	--	--	--
30...	--	--	--	--	--	--	--
AUG							
14...	98	100	--	--	--	--	--
15...	--	--	--	98	100	--	--
SEP							
07...	--	--	--	95	100	--	--
10...	--	--	--	99	100	--	--

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.°C), WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4440	7820	9020	10100	10000	11700	16000	15400	4090	5770	4160	8350
2	4730	7480	8860	10200	10100	11800	16300	16000	3560	5800	4920	8360
3	4950	6580	8630	10200	10100	14700	16300	16500	3300	4060	6020	6160
4	5050	6670	8560	10200	10400	14700	16100	16600	3300	3990	7950	6180
5	5200	6500	8630	10300	10500	13200	16100	3590	3260	3990	10200	5180
6	6150	6580	8710	10200	10600	13300	16100	4530	3210	4510	12900	5180
7	6930	7030	8710	10300	10500	12000	16100	4410	3000	4490	10600	2450
8	7220	6980	8780	10300	10500	11900	16400	4350	3070	4510	10600	2450
9	7760	7170	9090	10300	10700	11400	16400	4510	3020	5710	9530	2650
10	8250	7650	9620	10300	10600	11300	16100	4760	3070	4040	3900	3310
11	8170	7880	9710	10300	10900	11500	16200	5260	3090	2600	2860	4060
12	8170	8190	9900	10200	10900	11500	16000	6110	3130	3120	3340	4320
13	8310	8520	9710	10300	10800	13100	16100	8220	3150	2850	3340	4340
14	8310	8520	9530	10300	10800	13100	16000	8140	3130	3370	1940	4870
15	8370	8810	9440	10200	10700	14200	16100	9180	3510	3290	1680	5260
16	9040	8810	9520	10300	10800	14100	15900	9180	3840	3280	1740	6110
17	9450	8970	9620	10300	11500	13000	16000	13800	4330	5430	2170	6540
18	9720	8150	9510	10100	11500	13000	15700	13800	4900	7210	2020	7230
19	9630	8290	9420	10100	12400	13200	15800	12100	6430	8560	2860	7670
20	9630	8970	9450	10000	12300	13200	16000	12400	6390	8210	2700	7820
21	9540	8000	9520	9900	11600	14000	16000	12400	8560	10000	2310	7950
22	9450	8000	9520	9900	11500	14000	15700	14800	8630	12700	2390	8350
23	9630	8120	9620	9900	11300	14000	15700	16400	8280	11200	2790	8350
24	9200	8120	9710	9810	11300	14000	15700	15500	8210	13400	3860	8230
25	9200	8060	10100	9450	11500	13600	15700	15600	9020	14700	4240	8230
26	8880	8060	10000	9450	11500	13600	15400	17300	4490	14700	4720	8160
27	8000	8460	10000	9280	11700	18800	15400	17300	4510	14900	6050	8430
28	7700	8460	10000	9450	11700	18600	15600	15500	4670	14600	6470	8430
29	7700	8970	10100	9630	---	16000	15600	15900	4670	1080	6820	9180
30	7760	9040	9980	9900	---	16000	16000	11400	4630	2940	10800	8630
31	7880	---	10000	10000	---	16000	---	11400	---	2870	10900	---
MEAN	7880	7960	9450	10000	11000	13700	16000	11400	4680	6710	5380	6410

WTR YR 1981 MEAN 9200 MAX 18800 MIN 1080

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG.°C), WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DAY	MAX	MIN JUNE	MEAN	MAX	MIN JULY	MEAN	MAX	MIN AUGUST	MEAN	MAX	MIN SEPTEMBER	MEAN
1				---	---	---	4100	2800	3570	9300	8100	8580
2				---	---	---	4900	3100	4220	9300	7230	8430
3				---	---	---	3900	3200	3580	7040	5990	6450
4				---	---	---	5100	3900	4470	5930	4970	5330
5				---	---	---	---	5300	---	5050	4970	5010
6				---	---	---	---	---	---	5050	4780	4940
7				---	---	---	---	6100	---	4760	4170	4460
8				---	---	---	---	5200	---	4140	3660	3910
9				7500	7300	7410	---	2600	---	3630	3360	3520
10				9680	3640	6300	4500	3000	3330	3340	2910	3180
11				3390	2540	2790	3000	2600	2720	3070	2840	2950
12				3240	2990	3070	2900	1100	2030	3170	2930	3060
13				3310	2840	3080	2600	1100	1930	3420	3100	3250
14				2930	2750	2820	2300	2000	2120	3730	3380	3570
15				3730	2960	3330	2000	1800	1950	4210	3710	3990
16				4500	3710	4090	1900	1700	1760	4410	4160	4230
17				5600	4400	5000	1900	1600	1740	---	---	---
18				7700	5600	6630	1900	800	1730	---	---	---
19				8700	7800	8330	2700	800	2150	---	---	---
20				8600	7600	8090	3000	2700	2880	---	---	---
21				---	8400	---	2700	2300	2520	---	---	---
22				---	---	---	2300	2100	2210	---	---	---
23				---	---	---	3100	2200	2670	---	---	---
24				---	---	---	3700	3100	3430	---	---	---
25				---	---	---	4000	3500	3730	---	---	---
26				---	---	---	5100	3800	4340	---	---	---
27				---	---	---	6000	4800	5530	---	---	---
28				---	---	---	6400	4800	6000	---	---	---
29				---	600	---	7300	6300	6810	---	---	---
30				4600	2700	3230	7600	3400	5970	---	---	---
31				2900	2600	2740	8500	7400	7870	---	---	---
MONTH				9680	600	4780	8500	800	3510	9300	2840	4680
YEAR	9680	600	4160									

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

TEMPERATURE, WATER (DEG.°C), WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981
ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21.0	14.5	7.0	8.0	6.5	15.0	22.0	27.0	21.0	30.5	29.5	29.0
2	25.5	13.0	11.5	8.0	6.5	15.5	16.5	22.5	23.0	25.5	25.5	28.5
3	21.0	15.0	9.0	9.0	5.0	16.5	16.0	20.5	24.0	30.5	26.0	23.5
4	25.0	12.5	8.5	8.5	9.0	11.5	19.0	21.0	24.5	29.5	27.0	24.0
5	19.0	13.5	12.5	9.0	7.0	15.0	18.5	23.5	24.0	30.0	25.0	24.5
6	20.0	15.0	11.5	10.5	7.0	14.5	14.0	25.0	24.5	28.0	25.5	22.5
7	25.5	13.5	12.5	8.0	7.0	9.5	13.5	18.0	26.0	28.5	24.0	21.0
8	20.0	15.5	13.5	8.0	7.5	11.5	20.0	19.0	27.5	33.0	24.0	20.5
9	19.0	19.0	6.5	8.5	11.0	9.5	20.5	23.5	28.0	28.5	25.0	20.0
10	23.0	13.5	5.0	9.0	9.0	10.5	23.0	22.5	28.0	28.5	25.0	24.0
11	22.0	14.5	9.5	8.5	11.0	12.5	18.0	19.5	29.0	29.0	25.5	25.0
12	23.0	15.0	8.5	8.0	5.5	11.0	23.0	27.0	26.5	25.0	24.0	25.0
13	22.5	14.0	7.5	7.0	5.0	16.0	25.0	25.0	26.0	27.5	23.5	24.5
14	23.0	15.0	6.0	5.0	11.5	15.5	18.0	26.0	25.0	31.0	26.0	24.0
15	18.0	14.5	12.0	6.5	7.5	12.5	16.0	22.5	22.5	28.0	26.5	23.5
16	19.0	14.0	12.0	7.0	8.0	13.0	22.0	23.0	23.0	29.5	24.0	27.0
17	19.0	13.5	12.5	6.0	15.5	17.5	23.0	22.0	25.0	30.0	25.0	21.5
18	19.5	13.0	11.0	5.0	15.0	15.0	18.0	22.5	29.0	32.0	25.0	19.0
19	14.5	5.0	7.0	3.5	18.0	15.0	19.0	26.5	28.0	29.5	26.0	25.0
20	19.0	4.0	5.5	3.0	12.0	15.5	21.5	25.0	28.5	35.0	27.0	19.5
21	19.0	9.0	5.0	4.5	7.5	15.0	21.5	25.5	33.0	29.0	27.0	20.0
22	15.0	4.0	3.0	6.5	9.0	11.0	22.0	27.0	34.0	27.0	25.5	21.5
23	18.5	4.0	5.0	5.0	11.0	16.5	22.5	27.5	28.0	33.5	23.5	21.0
24	16.5	5.5	6.0	8.5	10.5	18.0	23.0	26.5	28.5	31.0	28.5	21.0
25	17.0	3.0	8.0	7.0	13.0	19.0	26.0	27.0	29.0	29.0	30.0	21.5
26	13.0	4.5	12.0	6.5	17.5	22.0	27.5	24.5	29.0	30.5	23.5	23.0
27	16.5	6.0	7.0	6.0	15.0	22.0	25.5	25.0	28.0	29.0	25.0	24.5
28	11.0	8.0	10.0	11.0	11.0	21.0	24.0	24.5	29.0	25.0	24.0	25.0
29	7.0	6.0	12.5	9.0	---	15.0	24.5	25.5	25.0	22.0	30.0	26.0
30	14.5	7.0	12.0	10.0	---	16.0	26.5	23.0	25.0	30.0	23.0	21.0
31	13.0	---	7.0	8.0	---	23.0	---	22.0	---	25.5	23.5	---
MEAN	18.5	11.0	9.0	7.5	10.0	15.0	21.0	24.0	26.5	29.0	25.5	23.0

WTR YR 1981 MEAN 18.5 MAX 35.0 MIN 3.0

WATER TEMPERATURE (DEG.°C), RECORDER MAXIMUM, AND MEAN, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

DAY	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN
		JUNE			JULY			AUGUST			SEPTEMBER	
1				---	---	---	33.0	25.0	28.5	25.5	21.5	23.5
2				---	---	---	35.5	24.0	29.5	29.0	21.0	24.5
3				---	---	---	31.0	26.5	28.5	30.0	22.5	26.0
4				---	---	---	32.0	25.0	28.5	24.5	21.5	23.0
5				---	---	---	34.0	24.5	29.0	22.5	21.5	22.0
6				---	---	---	34.0	24.5	29.0	23.5	20.5	22.0
7				---	---	---	26.5	23.0	25.0	23.0	21.5	22.5
8				---	---	---	30.0	21.5	25.5	21.5	20.5	21.0
9				29.5	25.5	27.5	28.0	22.5	25.5	20.5	20.0	20.5
10				28.0	22.5	25.5	28.5	24.0	26.5	22.0	20.0	21.0
11				29.5	25.0	27.0	26.0	23.0	24.5	23.5	21.5	22.5
12				29.0	24.5	27.0	26.0	22.5	24.0	24.5	22.5	23.5
13				30.0	25.0	27.5	24.0	22.5	23.5	25.5	23.5	24.5
14				31.5	24.5	28.0	24.5	21.5	24.0	25.5	23.5	24.5
15				33.5	25.0	28.5	25.5	24.0	25.0	25.0	23.0	24.0
16				32.5	24.0	28.0	27.0	23.5	25.0	23.5	22.0	23.0
17				32.5	24.0	27.5	27.5	24.0	25.5	---	---	---
18				34.5	24.0	29.0	27.0	24.5	25.5	---	---	---
19				35.5	24.5	29.5	27.5	24.0	26.0	---	---	---
20				35.5	24.5	30.0	27.5	23.5	25.5	---	---	---
21				35.5	24.5	29.5	27.5	23.5	25.5	---	---	---
22				34.5	22.5	28.0	28.0	23.0	25.5	---	---	---
23				34.5	23.0	27.5	29.0	22.5	26.0	---	---	---
24				34.5	23.0	27.5	29.5	23.0	26.0	---	---	---
25				34.0	21.5	27.0	31.0	22.5	26.5	---	---	---
26				34.0	22.5	27.5	31.5	22.5	27.0	---	---	---
27				33.0	23.0	27.0	31.5	23.5	27.0	---	---	---
28				28.5	22.5	25.0	31.5	22.5	26.5	---	---	---
29				27.5	21.0	24.5	32.0	22.5	26.5	---	---	---
30				30.0	25.0	27.5	32.5	22.5	27.0	---	---	---
31				32.0	25.0	28.0	32.0	22.5	26.5	---	---	---
MONTH				35.5	21.0	27.5	35.5	21.5	26.5	30.0	20.0	23.0
YEAR	35.5	20.0	26.0									

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1980 TO SEPTEMBER 1981

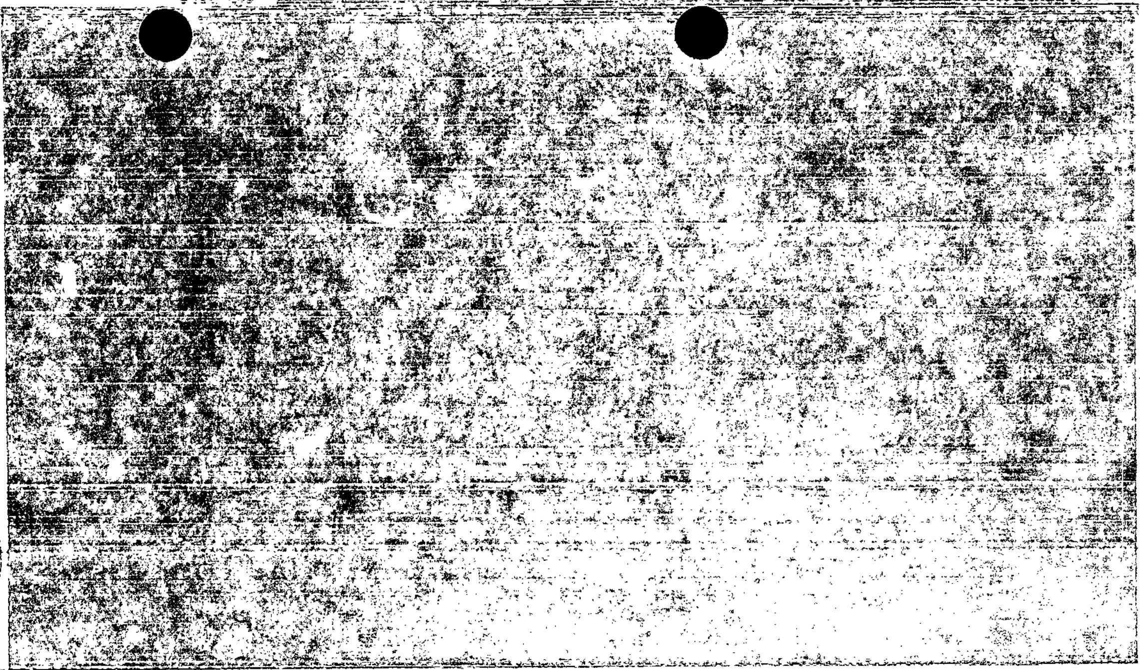
DAY	OCTOBER MEAN CONCENTRATION (MG/L)	OCTOBER LOADS (T/DAY)	NOVEMBER MEAN CONCENTRATION (MG/L)	NOVEMBER LOADS (T/DAY)	DECEMBER MEAN CONCENTRATION (MG/L)	DECEMBER LOADS (T/DAY)	JANUARY MEAN CONCENTRATION (MG/L)	JANUARY LOADS (T/DAY)	FEBRUARY MEAN CONCENTRATION (MG/L)	FEBRUARY LOADS (T/DAY)	MARCH MEAN CONCENTRATION (MG/L)	MARCH LOADS (T/DAY)
1	191	77	70	15	18	3.3	17	1.9	37	4.5	12	.58
2	191	68	21	4.6	15	2.7	24	2.5	73	8.5	20	1.0
3	175	59	28	5.9	11	2.0	21	2.3	11	1.3	10	.68
4	167	46	24	5.3	8	1.4	11	1.2	10	1.2	10	.84
5	99	25	38	8.3	12	2.0	12	1.4	5	.61	14	1.4
6	79	17	23	4.5	26	4.4	11	1.3	6	.76	11	.98
7	66	12	22	3.9	27	4.3	10	1.1	8	.99	11	1.0
8	27	4.7	22	3.8	33	4.9	10	1.2	10	1.3	7	.57
9	22	3.6	26	4.3	10	1.3	10	1.2	5	.63	14	.72
10	32	5.5	18	2.8	12	1.6	8	.97	6	.73	12	.97
11	34	5.7	18	2.6	20	2.6	49	6.0	10	1.2	6	.39
12	32	5.1	13	1.8	15	2.0	15	1.8	20	2.4	8	.39
13	40	6.5	16	2.1	15	2.0	35	4.2	17	1.9	14	.79
14	40	6.3	46	5.6	14	1.9	12	1.4	23	2.4	18	1.1
15	66	9.4	17	2.0	5	.66	32	3.7	7	.59	14	.95
16	36	4.6	38	5.1	5	.65	10	1.2	7	.68	13	.91
17	37	4.6	25	3.8	4	.52	12	1.5	4	.29	18	1.4
18	25	3.1	17	2.7	12	1.6	10	1.3	5	.38	16	1.2
19	20	2.5	35	6.1	23	3.0	80	11	11	.98	34	2.8
20	22	2.8	31	5.4	24	3.1	20	2.8	12	1.1	32	2.2
21	18	2.3	16	2.8	52	6.7	9	1.3	10	.92	107	6.1
22	17	2.2	41	6.8	129	17	8	1.1	9	.95	18	.97
23	20	2.6	17	2.7	32	4.1	12	1.7	12	1.3	22	1.2
24	14	1.8	46	7.1	23	3.0	11	1.5	10	1.1	19	1.0
25	27	3.8	16	2.7	22	2.8	10	1.4	10	1.0	20	1.0
26	14	2.3	14	2.5	30	3.8	10	1.4	10	.92	22	.83
27	23	4.0	17	3.0	24	3.0	15	2.1	9	.75	27	.95
28	19	3.0	19	3.4	69	8.4	8	1.0	10	.73	28	1.1
29	24	3.8	21	3.8	99	12	8	1.0	---	---	27	.87
30	20	3.6	48	8.8	26	3.2	12	1.5	---	---	57	1.7
31	21	4.2	---	---	13	1.5	10	1.2	---	---	93	2.5
TOTAL	---	402.0	---	139.2	---	111.43	---	65.17	---	40.11	---	39.09

DAY	APRIL MEAN CONCENTRATION (MG/L)	APRIL LOADS (T/DAY)	MAY MEAN CONCENTRATION (MG/L)	MAY LOADS (T/DAY)	JUNE MEAN CONCENTRATION (MG/L)	JUNE LOADS (T/DAY)	JULY MEAN CONCENTRATION (MG/L)	JULY LOADS (T/DAY)	AUGUST MEAN CONCENTRATION (MG/L)	AUGUST LOADS (T/DAY)	SEPTEMBER MEAN CONCENTRATION (MG/L)	SEPTEMBER LOADS (T/DAY)
1	44	1.1	29	1.0	5750	11100	144	14	2220	288	77	5.4
2	22	.71	25	.74	3400	6730	187	38	200	9.7	74	16
3	22	.77	29	1.1	2860	5710	1120	148	128	4.5	29	4.7
4	21	.57	27	7.8	3510	7030	408	124	127	4.5	290	34
5	19	.48	20	4.4	2580	5260	372	71	133	7.2	450	69
6	13	.39	14	1.8	3130	6660	1820	226	56	2.7	4000	6100
7	18	.73	4990	4820	2600	5140	1810	132	1360	77	4460	5740
8	22	.89	4960	2570	2390	4630	1280	66	2080	146	4140	4990
9	25	.81	3980	1230	2160	3990	155	5.9	5760	2970	2710	2040
10	39	1.8	1820	359	2090	3370	4630	1980	8490	3850	1920	1150
11	35	1.7	632	77	1850	2640	5430	3370	7720	2330	1310	672
12	23	.75	136	9.9	1790	2130	4850	2210	9630	6050	1050	451
13	19	.72	58	3.0	1550	1710	6140	2900	13800	29300	960	345
14	18	.97	60	2.3	889	406	4950	1260	10400	18200	525	206
15	17	.78	30	1.1	514	133	2820	388	7180	8280	347	128
16	42	2.5	34	1.2	299	50	2860	263	5300	4090	88	24
17	34	1.8	70	3.8	99	13	143	8.9	4180	3990	36	7.7
18	26	1.3	71	5.4	65	5.8	210	14	4970	6010	47	9.3
19	26	1.3	72	5.4	43	3.0	186	9.0	2000	1470	44	9.0
20	24	1.7	67	4.0	45	2.8	97	3.7	2300	1650	30	5.9
21	33	2.6	63	3.9	170	11	96	3.9	1650	1160	33	5.9
22	33	2.0	73	4.3	228	18	80	1.9	902	451	23	4.3
23	39	2.1	73	4.1	39	2.5	100	2.7	536	197	26	4.8
24	56	3.6	111	4.8	35	1.9	83	1.5	383	111	30	5.5
25	55	4.6	106	5.4	32	1.3	119	1.3	161	31	35	6.4
26	34	1.7	116	6.6	413	68	111	1.2	45	7.3	22	3.7
27	38	1.6	110	5.6	388	104	81	.66	32	4.2	24	3.8
28	29	2.0	64	3.1	198	30	65	.86	34	3.5	29	4.4
29	30	1.5	54	2.5	146	14	3900	1630	40	3.8	29	4.9
30	50	2.0	3750	2290	267	24	9870	3700	59	4.9	26	4.5
31	---	---	3800	6180	---	---	6360	1320	74	5.8	---	---
TOTAL	---	45.47	---	17619.24	---	66988.3	---	19895.52	---	90709.1	---	22055.2

TOTAL LOAD FOR YEAR: 218109.83 TONS.

n6061

Lepp



Water Resources Data for New Mexico

U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NM-80-1

WATER YEAR 1980

Prepared in cooperation with the State of New Mexico and with other agencies

08396500 PECOS RIVER NEAR ARTESIA, NM
(Surveillance-program station)

LOCATION.--Lat 32°50'25", long 104°19'23", in NW¼NW¼ sec.18, T.17 S., R.27 E., Eddy County, Hydrologic Unit 13060007, near left bank on downstream end of bridge pier on State Highway 83, 4.3 mi (6.9 km) east of Artesia, 7.0 mi (11.3 km) upstream from Rio Penasco, 17 mi (27.4 km) upstream from McMillan Dam, and at mile 503.9 (810.8 km).

DRAINAGE AREA.--15,300 mi^2 (39,630 km^2), approximately (contributing area).

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--September 1905 to June 1909, August 1909 to current year. Monthly discharge only for some periods, published in WSP 1312 and 1712. Records for Aug. 22-31, 1934, and October 1936 to April 1937, published in WSP 763 and 828, respectively are not reliable and should not be used. Prior to February 1936, published as "near Dayton."

REVISED RECORDS.--WSP 1312 and 1512: 1913, 1915, 1917-18(M), 1920, 1923, 1931-36. WSP 1712: 1906(M), 1908-11(M), 1919, 1921-23(M), 1929, 1931-32(M), 1935-36(M), 1937, 1939(M), 1941(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 3,291.92 ft (1,003.376 m) National Geodetic Vertical Datum of 1929. Prior to Aug. 27, 1914, nonrecording gage and Aug. 27, 1914, to Feb. 20, 1936, water-stage recorder at site 6.5 mi (10.5 km) downstream at different datum. Feb. 21, 1936, to Apr. 4, 1941, water-stage recorder at site 600 ft (183 m) downstream at different datum.

REMARKS.--Water-discharge records fair. Flow partly regulated by Lake Sumner (station 08384000) since August 1937. Diversions and ground-water withdrawals for irrigation of about 154,000 acres (620 km^2), 1959 determination, above station.

AVERAGE DISCHARGE.--44 years, 250 ft^3/s (7.080 m^3/s) 181,100 acre-ft/yr (223 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge probably occurred May 30, 1937, when a discharge of 51,500 ft^3/s (1,460 m^3/s) was measured by slope-area method at a point 15 mi (24.1 km) upstream, gage height, 14.7 ft (4.48 m), site and datum then in use; no flow at times in 1934, 1946-47, 1953-54, 1957, 1964-65.

EXTREMES OUTSIDE PERIOD OF RECORD.--Greatest flood since at least 1893 occurred Oct. 2, 1904, discharge not determined; the peak inflow to Lake McMillan, which includes Rio Penasco and Fourmile Draw, was estimated at 82,000 ft^3/s (2,320 m^3/s). The second highest flood occurred July 25, 1905, discharge below Rio Penasco, 50,300 ft^3/s (1,420 m^3/s), based on gain in storage and spill from Lake McMillan. The floods in August 1893 and October 1904 damaged McMillan Dam and washed out Avalon Dam.

EXTREMES FOR CURRENT YEAR.--Maximum discharge 1,670 ft^3/s (47.3 m^3/s) Sept. 12, gage height, 9.00 ft (2.743 m) no peak above base of 2,000 ft^3/s (57 m^3/s); minimum, 3.4 ft^3/s (0.096 m^3/s) June 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25	165	54	62	83	49	25	417	23	583	204	14
2	25	149	54	62	92	48	18	194	22	576	125	21
3	22	137	55	62	104	48	18	173	25	593	99	14
4	19	131	56	62	106	51	22	148	19	593	72	11
5	13	128	56	60	94	48	21	131	17	617	45	9.6
6	12	114	58	59	86	46	20	103	16	641	39	12
7	13	103	59	60	80	45	21	83	11	655	50	11
8	14	93	59	60	71	42	22	83	8.9	718	71	8.9
9	17	87	57	59	72	41	21	71	8.2	740	52	38
10	14	84	55	57	70	41	21	62	7.5	720	49	100
11	13	81	54	56	65	42	21	56	7.5	720	44	240
12	13	78	54	57	68	39	34	105	6.4	715	46	1070
13	13	76	57	57	70	39	468	84	4.9	720	50	497
14	15	75	64	57	72	38	638	51	5.2	715	55	537
15	15	70	62	58	72	37	619	44	16	698	44	564
16	15	69	69	57	72	37	619	53	17	705	217	668
17	15	67	72	56	75	36	641	54	7.5	720	107	415
18	411	66	74	51	75	36	680	64	4.7	718	49	216
19	739	64	70	50	74	34	670	132	4.7	715	27	169
20	780	62	66	50	72	30	672	98	4.7	710	31	140
21	444	59	68	53	74	28	692	64	4.1	725	25	114
22	185	59	68	59	69	25	690	53	4.1	730	35	93
23	314	59	66	74	64	22	718	39	57	750	33	82
24	760	59	66	75	61	19	718	31	419	710	19	68
25	828	57	66	87	58	17	732	30	487	690	12	75
26	873	57	64	84	55	16	808	29	524	700	11	125
27	905	56	64	83	52	14	795	28	540	690	14	248
28	877	55	64	83	51	15	715	27	547	685	12	359
29	393	54	64	83	51	17	735	24	571	730	9.6	235
30	230	55	62	82	---	16	738	24	595	649	11	173
31	174	---	62	82	---	17	---	27	---	534	11	---
TOTAL	8186	2469	1919	1997	2108	1033	12612	2582	3984.4	21165	1668.6	6327.5
MEAN	264	82.3	61.9	64.4	72.7	33.3	420	83.3	133	683	53.8	211
MAX	905	165	74	87	106	51	808	417	595	750	217	1070
MIN	12	54	54	50	51	14	18	24	4.1	534	9.6	8.9
AC-FT	16240	4900	3810	3960	4180	2050	25020	5120	7900	41980	3310	12550

CAL YR 1979 TOTAL 53623.1 MEAN 147 MAX 1170 MIN 3.9 AC-FT 106400
WTR YR 1980 TOTAL 66051.5 MEAN 180 MAX 1070 MIN 4.1 AC-FT 131000

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1937 to current year.
PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: July 1937 to current year.
WATER TEMPERATURES: April 1949 to current year.
SUSPENDED SEDIMENT DISCHARGE: January 1949 to current year.
EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily, 28,800 micromhos June 24, 1977; minimum daily, 464 micromhos Sept. 23, 1974.
WATER TEMPERATURES: Maximum, 36.0°C July 27, 1966, July 25, 1969; minimum, 0.0°C on many days during winter months of most years.
SEDIMENT CONCENTRATIONS: Maximum daily, 21,300 mg/L Aug. 1, 1962; minimum daily, no flow on many days during July 1953, July and August 1954, July 1957, July to October 1964.
SEDIMENT LOADS: Maximum daily, 183,000 tons (166,000 tonnes) Sept. 26, 1955; minimum daily, 0 tons (0 tonnes) on many days during July 1953, July and August 1954, July 1957, July to October 1964.
EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily, 26,000 micromhos Mar. 28; minimum daily, 1,160 micromhos July 24, 26.
WATER TEMPERATURES: Maximum, 33.0°C June 13, 23; minimum, 3.0°C Dec. 2, 16-17.
SEDIMENT CONCENTRATIONS: Maximum daily, 5,950 mg/L Sept. 17; minimum daily, 5 mg/L Mar. 15
SEDIMENT LOADS: Maximum daily, 9,380 tons (8,510 tonnes) Oct. 19; minimum daily, 0.20 ton (0.18 tonne) June 18.

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	STREAM-FLOW, INSTANTANEOUS (CFS) (00061)	SPECIFIC CONDUCTANCE (MICROMHOS) (00095)	PH FIELD (UNITS) (00400)	TEMPERATURE, AIR (DEG C) (00020)	TEMPERATURE, WATER (DEG C) (00010)	TURBIDITY (NTU) (00076)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN DEMAND, CHEMICAL (HIGH LEVEL) (MG/L) (00340)	HARDNESS (MG/L AS CACO3) (00900)
OCT										
12...	0912	13	13800	8.1	24.5	15.5	12	9.0	59	3400
NOV										
09...	0945	87	4050	8.5	15.5	10.5	63	10.2	35	1500
DEC										
05...	0845	56	7300	8.5	16.0	5.0	4.8	--	150	2000
JAN										
18...	1030	51	8700	8.6	19.5	9.0	1.1	13.2	49	2100
FEB										
26...	1000	55	8770	8.4	23.0	11.0	2.8	14.4	72	2400
MAR										
25...	0945	17	14900	8.3	23.5	15.0	5.9	11.6	3400	3300
APR										
30...	0930	738	2170	8.1	31.0	19.0	560	7.0	2	1100
MAY										
27...	1030	28	6250	8.2	31.0	25.0	37	8.2	160	2100
JUN										
24...	1030	419	3600	7.9	39.0	25.5	4000	4.8	180	1600
JUL										
22...	1000	730	1200	8.2	32.0	25.0	420	3.2	32	580
AUG										
26...	1030	11	7200	8.3	34.5	27.0	17	7.2	41	1500
SEP										
29...	1030	235	2800	8.1	23.0	20.0	460	7.4	64	1000

DATE	HARDNESS, NONCARBONATE (MG/L CACO3) (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM ADSORPTION RATIO (00931)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY (MG/L AS CACO3) (00410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)
OCT										
12...	3300	500	520	2100	16	22	130	3200	3700	.8
NOV										
09...	1400	420	110	450	5.1	7.6	130	1100	770	.5
DEC										
05...	1900	430	230	1000	9.7	9.5	170	2600	860	.8
JAN										
18...	2000	480	220	1200	11	11	150	1800	2100	.9
FEB										
26...	2300	560	240	1200	11	11	100	1800	2100	.6
MAR										
25...	3100	750	340	2400	18	21	190	2600	4200	.9
APR										
30...	1000	370	49	110	1.4	4.2	96	970	150	.6
MAY										
27...	2000	540	190	1100	10	13	97	1600	1900	.5
JUN										
24...	1500	470	100	320	3.5	9.5	100	1500	480	.9
JUL										
22...	490	190	26	55	1.0	2.9	88	470	74	.7
AUG										
26...	1400	420	110	930	10	13	110	1300	1600	.5
SEP										
29...	--	280	76	380	5.2	9.5	--	720	650	.6

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, RESIDUE AT 105 DEG. C, SUS-PENDED (MG/L) (00530)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N) (00605)
OCT									
12...	9.0	9990	10100	35	.71	.73	.270	.260	.54
NOV									
09...	15	3200	2960	154	.83	.84	.170	.090	.44
DEC									
05...	16	5770	5260	17	1.6	1.6	.340	.260	1.5
JAN									
18...	11	6210	5920	12	.83	.83	.230	.260	1.8
FEB									
26...	14	6070	5990	7	.02	.06	.940	.120	1.2
MAR									
25...	7.8	10700	10400	15	.04	.04	.180	.170	1.1
APR									
30...	8.4	1810	1720	1250	.09	.10	.140	.110	1.5
MAY									
27...	12	5920	5410	81	.00	.00	.200	.220	1.3
JUN									
24...	8.0	3090	2950	1670	.32	.19	.380	.400	2.3
JUL									
22...	7.1	945	879	224	.01	.05	.010	.000	2.6
AUG									
26...	8.8	4730	4450	19	.00	.00	.350	.070	.75
SEP									
29...	12	2430	2130	748	.63	.59	.120	.060	2.1

DATE	NITRO-GEN, TOTAL (MG/L AS N) (00600)	PHOS-PHORUS, TOTAL (MG/L AS P) (00665)	PHOS-PHORUS, ORTHOPH OSPHATE DISSOL. (MG/L AS P) (00671)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	CARBON, ORGANIC TOTAL (MG/L AS C) (00680)	CARBON, ORGANIC DIS-SOLVED (MG/L AS C) (00681)	CARBON, ORGANIC SUS-PENDED (MG/L AS C) (00689)
OCT									
12...	1.5	.070	.010	990	50	--	--	4.5	.9
NOV									
09...	1.4	.070	.010	280	20	--	--	4.8	.6
DEC									
05...	3.4	.100	.020	470	60	20	8.5	5.6	1.7
JAN									
18...	2.8	.090	.040	490	30	--	--	5.2	--
FEB									
26...	2.1	.280	.000	510	70	--	--	9.5	22
MAR									
25...	1.3	.110	.040	870	50	440	--	5.4	1.9
APR									
30...	1.7	.870	.000	100	110	20	5.3	2.4	.5
MAY									
27...	1.5	.090	.000	580	50	--	--	6.6	1.6
JUN									
24...	3.0	1.700	.000	310	160	20	50	6.9	.6
JUL									
22...	2.6	.670	.010	100	50	--	--	9.4	1.1
AUG									
26...	1.1	.030	.000	420	50	--	--	4.8	1.9
SEP									
29...	2.8	.590	.030	110	840	--	--	5.3	.6

TRACE ELEMENT ANALYSES, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	ARSENIC TOTAL (UG/L AS AS) (01002)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, TOTAL RECOV-ERABLE (UG/L AS BA) (01007)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BORON, DIS-SOLVED (UG/L AS B) (01020)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD) (01027)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR) (01034)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)
DEC 05...	0845	2	1	400	300	470	0	0	0	10
MAR 25...	0945	--	1	--	200	870	--	1	--	20
APR 30...	0930	3	1	800	400	100	1	0	30	10
JUN 24...	1030	10	1	1000	100	310	0	1	50	10

DATE	COBALT, TOTAL RECOV-ERABLE (UG/L AS CO) (01037)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU) (01042)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE) (01045)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB) (01051)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN) (01055)
DEC 05...	3	0	1	2	300	60	6	2	40
MAR 25...	--	0	--	1	--	50	--	1	--
APR 30...	11	0	27	3	19000	110	55	2	930
JUN 24...	18	0	150	44	33000	160	57	4	3600

DATE	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG) (71900)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	SELE-NIUM, TOTAL (UG/L AS SE) (01147)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, TOTAL RECOV-ERABLE (UG/L AS AG) (01077)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN) (01092)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
DEC 05...	20	.1	.0	2	4	0	0	40	60
MAR 25...	440	--	.1	--	2	--	0	--	80
APR 30...	20	.1	.0	0	1	0	0	150	150
JUN 24...	20	.1	.0	2	1	0	0	230	30

CHEMICAL ANALYSES OF BOTTOM MATERIAL, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	ARSENIC TOTAL IN BOT-TOM MA-TERIAL (UG/G AS AS) (01003)	CADMIUM RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CD) (01028)	CHRO-MIUM, RECOV. FM BOT-TOM MA-TERIAL (UG/G) (01029)	COPPER, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CU) (01043)	LEAD, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS PB) (01052)	MERCURY RECOV. FM BOT-TOM MA-TERIAL (UG/G AS HG) (71921)
SEP 29...	1030	0	1	1	2	0	.01

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

PESTICIDE ANALYSES, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	PCB TOTAL (UG/L) (39516)	ALDRIN, TOTAL (UG/L) (39330)	CHLOR-DANE, TOTAL (UG/L) (39350)	DDD, TOTAL (UG/L) (39360)	DDE, TOTAL (UG/L) (39365)	DDT, TOTAL (UG/L) (39370)	DI-AZINON, TOTAL (UG/L) (39570)	DI-ELDRIN TOTAL (UG/L) (39380)
SEP									
29...	1030	.00	.00	.0	.00	.00	.00	.01	.00

DATE	ENDO-SULFAN, TOTAL (UG/L) (39388)	ENDRIN, TOTAL (UG/L) (39390)	ETHION, TOTAL (UG/L) (39398)	HEPTA-CHLOR, TOTAL (UG/L) (39410)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L) (39420)	LINDANE TOTAL (UG/L) (39340)	MALA-THION, TOTAL (UG/L) (39530)	METH-OXY-CHLOR, TOTAL (UG/L) (39480)	METHYL PARA-THION, TOTAL (UG/L) (39600)
SEP									
29...	.00	.00	.00	.00	.00	.00	.00	.00	.00

DATE	METHYL TRI-THION, TOTAL (UG/L) (39790)	PARA-THION, TOTAL (UG/L) (39540)	TOX-APHENE, TOTAL (UG/L) (39400)	TOTAL TRI-THION (UG/L) (39786)	2,4,5-T TOTAL (UG/L) (39740)	SILVEX, TOTAL (UG/L) (39760)	PER-THANE TOTAL (UG/L) (39034)	NAPH-THA-LENES, POLY-CHLOR. TOTAL (UG/L) (39250)	MIREX, TOTAL (UG/L) (39755)
SEP									
29...	.00	.00	0	.00	.00	.00	.00	.0	.00

MICROBIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT			
12...	0912	53	460
NOV			
09...	0945	20	85
DEC			
05...	0845	1	25
JAN			
18...	1030	54	58
FEB			
26...	1000	160	800
MAR			
25...	0945	7	12
APR			
30...	0930	230	1600
MAY			
27...	1030	3	12
JUN			
24...	1030	14	980
JUL			
22...	1000	100	130
AUG			
26...	1030	28	28
SEP			
29...	1030	2000	5200

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DATE	TIME	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	TEMPERATURE, WATER (DEG C) (00010)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)
OCT									
28...	0810	877	14.0	2470	5850	37	43	--	61
DEC									
05...	0845	56	5.0	55	8.3	64	69	72	75
JAN									
18...	1030	51	9.0	26	3.6	--	--	--	--
FEB									
26...	1000	55	11.0	29	4.3	--	--	--	--
MAR									
25...	0945	17	15.0	34	1.6	--	--	--	--
APR									
14...	0910	638	10.0	2440	4200	33	43	--	66
27...	0900	795	13.0	1830	3930	31	38	--	54
30...	0930	738	19.0	1950	3890	24	33	--	43
MAY									
27...	1030	28	25.0	100	7.6	--	--	--	--
JUN									
24...	1030	419	25.5	4720	5340	38	49	--	73
26...	1112	524	26.0	2470	3500	35	45	--	65
JUL									
02...	1600	576	27.0	1280	1990	39	49	--	67
22...	1000	730	25.0	1990	3920	22	25	--	35
AUG									
16...	1000	217	27.0	2040	1200	26	42	--	72
26...	1030	11	27.0	33	.98	--	--	--	--
SEP									
12...	1300	1070	24.0	2980	8610	35	44	--	57
18...	1535	216	26.0	3900	2270	64	82	--	98
29...	1030	235	20.0	945	600	42	51	--	71

DATE	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)	SED. SUSP. SIEVE DIAM. % FINER THAN .125 MM (70332)	SED. SUSP. SIEVE DIAM. % FINER THAN .250 MM (70333)	SED. SUSP. SIEVE DIAM. % FINER THAN .500 MM (70334)
OCT									
28...	--	--	--	--	--	95	100	--	--
DEC									
05...	79	--	--	--	--	85	90	100	--
JAN									
18...	--	--	--	--	--	35	64	97	100
FEB									
26...	--	--	--	--	--	41	63	94	100
MAR									
25...	--	--	--	--	--	39	72	96	100
APR									
14...	--	95	100	--	--	--	--	--	--
27...	--	92	100	--	--	--	--	--	--
30...	--	84	95	100	--	--	--	--	--
MAY									
27...	--	--	--	--	--	76	85	96	100
JUN									
24...	--	90	96	100	--	--	--	--	--
26...	--	95	100	--	--	--	--	--	--
JUL									
02...	--	--	--	--	--	97	100	--	--
22...	--	71	87	96	100	--	--	--	--
AUG									
16...	--	--	--	--	--	99	100	--	--
26...	--	--	--	--	--	85	92	100	--
SEP									
12...	--	82	96	100	--	--	--	--	--
18...	--	100	--	--	--	--	--	--	--
29...	--	--	--	--	--	87	95	100	--

08396500 PECOS RIVER NEAR ARTESIA, NM -- Continued

WATER-QUALITY RECORDS

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG. C), WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11700	2850	7510	7960	8000	9450	15100	2200	10400	2330	1890	14900
2	11800	2830	7740	7790	7590	9450	12900	2470	11300	2310	2360	11700
3	11100	3000	7670	7960	7110	9720	13200	2700	12000	2280	2740	11600
4	10800	3160	7800	7840	6290	9900	14500	2720	11200	2290	3180	10100
5	10800	3400	7830	7960	6070	9810	13600	3240	11700	2290	3300	10200
6	10200	3470	7920	8070	6250	10100	13100	3420	13700	2290	3490	10900
7	11700	3730	7870	8010	6760	9900	13300	3800	13700	2290	3570	11300
8	14800	3980	7830	8070	7240	10300	12600	4170	13400	2320	3960	13700
9	14900	4030	7770	8130	7320	10400	12200	4520	13600	2300	4020	12400
10	14100	4270	7790	8060	7500	10500	12100	5050	13600	2290	4980	7230
11	13100	4400	7770	8200	7820	10400	12300	5470	14200	2300	5340	3850
12	13500	4510	7890	8260	7770	10500	12400	5530	16700	2290	5370	1460
13	15000	4540	7930	8450	7980	10700	12800	4680	14800	2330	5340	1390
14	15100	4910	7670	8450	8860	10700	3050	4940	18300	2280	6080	1480
15	15000	5210	7690	8320	8230	11100	2470	5120	21500	2270	5870	1900
16	14800	5300	7790	8320	7800	10900	2310	5220	13400	2170	5770	2280
17	14900	5370	7760	8320	7210	11100	2230	5530	12700	2020	2510	1920
18	9080	5960	8070	8520	7470	11700	2200	5830	11500	1860	2830	1870
19	2140	6110	7730	8720	7510	11400	2170	6270	11200	1700	3110	2040
20	1580	6340	7420	8780	7610	11700	2150	4520	12400	1530	4700	2640
21	1690	6470	7260	8790	7750	12100	2130	4640	14500	1240	6520	3450
22	1770	6720	7210	7620	8070	12600	2100	4820	16200	1260	6600	3810
23	1960	6740	7460	7840	7850	13500	2140	5050	18800	1180	5910	4270
24	1910	6980	7720	7960	7830	13900	2140	5560	3560	1160	5840	4900
25	1470	7210	7710	7680	8100	14800	2180	7160	2640	1170	5840	5540
26	1470	7190	7670	7730	8380	15300	2190	7620	2510	1160	6970	3330
27	1470	7320	7510	7900	8570	16400	2200	8080	2330	1280	7650	4540
28	1480	7490	7620	7790	8910	26000	2210	8510	2320	1260	9620	1940
29	1640	7530	7890	7790	8880	15500	2110	9380	2350	1210	11000	3250
30	1930	7540	7970	7660	---	14900	2110	10300	2310	1350	10900	3370
31	2250	---	8080	7790	---	14000	---	10500	---	1390	11200	---
MEAN	8230	5290	7730	8090	7680	12200	6940	5450	11300	1850	5430	5780

WTR YR 1980 MEAN 7160 MAX 26000 MIN 1160

TEMPERATURE, WATER (DEG. C), WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

ONCE-DAILY

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	24.0	10.0	7.5	5.5	6.0	9.5	11.0	20.0	24.0	26.5	27.0	29.0
2	16.5	11.0	3.0	6.5	4.5	12.0	17.0	21.0	26.5	27.0	25.0	22.5
3	24.5	13.0	6.0	6.5	7.5	7.0	18.0	19.0	29.0	27.0	30.0	29.0
4	27.5	10.0	7.0	5.5	9.5	10.0	19.0	19.5	24.0	27.5	29.0	26.0
5	23.5	10.5	6.0	5.0	9.0	10.5	17.0	24.0	31.0	26.0	24.5	27.0
6	16.0	11.5	9.0	7.0	9.0	13.0	22.0	24.0	29.5	26.5	28.0	24.5
7	25.0	11.0	5.0	5.5	10.5	12.0	18.0	25.5	29.0	27.5	23.5	26.0
8	18.5	11.0	10.0	5.0	8.0	12.0	20.0	26.0	26.0	27.0	30.0	27.0
9	15.0	14.0	9.5	8.0	4.5	15.0	12.5	23.5	26.0	27.5	29.0	24.0
10	14.5	11.5	10.0	5.0	3.5	15.0	20.0	23.0	25.0	27.5	28.0	20.0
11	22.0	13.5	11.5	8.0	4.5	15.0	23.0	22.0	25.0	26.5	26.5	21.0
12	16.0	11.5	7.5	9.0	6.0	13.0	21.5	22.0	28.0	27.0	24.5	21.5
13	15.0	12.5	7.0	10.5	5.0	18.0	20.0	20.0	33.0	27.5	23.0	24.5
14	15.5	11.5	5.0	10.0	8.5	10.0	10.0	19.0	30.0	28.0	26.0	23.0
15	22.0	11.0	4.0	12.5	12.0	14.0	13.0	21.0	28.5	27.5	25.0	24.0
16	24.5	10.0	3.0	9.0	12.0	15.0	15.0	19.0	29.5	28.0	27.0	24.5
17	17.0	7.5	3.0	9.0	6.5	13.5	17.5	16.5	29.0	28.0	25.0	23.0
18	17.0	13.0	3.5	10.0	13.0	13.0	19.0	24.0	31.5	27.5	25.5	26.0
19	16.5	12.0	5.5	11.5	11.0	17.0	16.5	24.0	29.0	26.0	26.0	22.5
20	16.5	10.0	9.0	7.0	11.5	15.0	19.0	28.0	30.0	25.5	25.0	23.0
21	17.0	13.5	7.0	7.5	11.0	16.0	18.0	24.5	28.0	26.5	23.5	27.0
22	13.5	6.5	9.5	6.5	13.0	16.0	18.0	27.0	26.0	26.5	24.5	21.0
23	12.5	5.0	9.0	5.0	11.5	10.0	20.5	26.0	33.0	27.0	28.5	20.5
24	12.5	8.0	11.5	5.0	10.5	13.5	17.5	26.0	28.0	28.5	27.0	22.5
25	13.0	11.0	9.0	7.0	10.0	18.0	16.0	26.0	27.0	26.5	27.0	22.0
26	15.0	8.0	6.5	4.0	10.5	20.0	15.0	27.5	26.0	27.0	25.5	18.0
27	15.5	11.0	8.0	5.0	11.0	18.0	13.0	25.0	26.0	25.0	23.0	18.0
28	14.0	7.0	7.5	5.5	12.0	17.0	19.0	23.5	26.5	26.5	30.5	17.5
29	14.0	4.0	4.5	5.0	13.0	12.0	18.0	27.5	27.0	28.0	27.0	18.5
30	13.5	5.5	5.0	5.0	---	16.0	20.0	27.5	27.5	26.0	29.5	21.5
31	12.0	---	5.0	5.0	---	12.0	---	29.5	---	28.0	31.5	---
MEAN	17.5	10.0	7.0	7.0	9.0	14.0	17.5	23.5	28.0	27.0	26.5	23.0

WTR YR 1980 MEAN 17.5 MAX 33.0 MIN 3.0

WATER-QUALITY RECORDS

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DAY	OCTOBER MEAN CONCENTRATION (MG/L)	OCTOBER LOADS (T/DAY)	NOVEMBER MEAN CONCENTRATION (MG/L)	NOVEMBER LOADS (T/DAY)	DECEMBER MEAN CONCENTRATION (MG/L)	DECEMBER LOADS (T/DAY)	JANUARY MEAN CONCENTRATION (MG/L)	JANUARY LOADS (T/DAY)	FEBRUARY MEAN CONCENTRATION (MG/L)	FEBRUARY LOADS (T/DAY)	MARCH MEAN CONCENTRATION (MG/L)	MARCH LOADS (T/DAY)
1	58	3.9	398	177	21	3.1	207	35	108	24	13	1.7
2	29	2.0	310	125	80	12	7	1.2	106	26	10	1.3
3	35	2.1	237	88	16	2.4	11	1.8	50	14	8	1.0
4	70	3.6	214	76	20	3.0	43	7.2	76	22	7	.96
5	47	1.6	198	68	39	5.9	6	.97	70	18	10	1.3
6	32	1.0	180	55	59	9.2	6	.96	66	15	9	1.1
7	218	7.7	151	42	73	12	11	1.8	72	16	6	.73
8	22	.83	98	25	38	6.1	7	1.1	77	15	7	.79
9	26	1.2	125	29	26	4.0	9	1.4	77	15	6	.66
10	19	.72	117	27	18	2.7	6	.92	32	6.0	10	1.1
11	23	.81	125	27	31	4.5	7	1.1	51	9.0	9	1.0
12	35	1.2	116	24	31	4.5	6	.92	25	4.6	8	.84
13	56	2.0	100	21	41	6.3	26	4.0	23	4.3	8	.84
14	24	.97	90	18	116	20	18	2.8	25	4.9	6	.62
15	30	1.2	86	16	21	3.5	12	1.9	46	8.9	5	.50
16	36	1.5	159	30	19	3.5	9	1.4	34	6.6	9	.90
17	23	.93	105	19	21	4.1	15	2.3	24	4.9	10	.97
18	4360	6320	40	7.1	14	2.8	47	6.5	34	6.9	9	.87
19	4700	9380	44	7.6	19	3.6	15	2.0	34	6.8	8	.73
20	2650	5580	38	6.4	28	5.0	17	2.3	57	11	8	.65
21	2130	2550	36	5.7	19	3.5	11	1.6	28	5.6	11	.83
22	1510	754	56	8.9	46	8.4	152	24	17	3.2	12	.81
23	1610	1830	178	28	38	6.8	38	7.6	18	3.1	8	.48
24	3130	6420	22	3.5	31	5.5	56	11	22	3.6	9	.46
25	3010	6730	35	5.4	26	4.6	50	12	33	5.2	20	.92
26	2780	6550	30	4.6	15	2.6	97	22	24	3.6	15	.65
27	2540	6210	115	17	27	4.7	70	16	18	2.5	15	.57
28	2330	5520	34	5.0	9	1.6	73	16	22	3.0	12	.49
29	1360	1440	23	3.4	10	1.7	48	11	14	1.9	16	.73
30	855	531	16	2.4	11	1.8	99	22	---	---	12	.52
31	617	290	---	---	30	5.0	58	13	---	---	14	.64
TOTAL	---	60138.26	---	972.0	---	164.4	---	233.77	---	270.6	---	25.66

DAY	APRIL MEAN CONCENTRATION (MG/L)	APRIL LOADS (T/DAY)	MAY MEAN CONCENTRATION (MG/L)	MAY LOADS (T/DAY)	JUNE MEAN CONCENTRATION (MG/L)	JUNE LOADS (T/DAY)	JULY MEAN CONCENTRATION (MG/L)	JULY LOADS (T/DAY)	AUGUST MEAN CONCENTRATION (MG/L)	AUGUST LOADS (T/DAY)	SEPTEMBER MEAN CONCENTRATION (MG/L)	SEPTEMBER LOADS (T/DAY)
1	16	1.1	1160	1370	63	3.9	1600	2520	553	305	40	1.5
2	19	.92	655	343	56	3.3	1300	2020	248	84	30	1.7
3	20	.97	513	240	64	4.3	1600	2560	130	35	39	1.5
4	31	1.8	505	202	49	2.5	3950	6320	125	24	25	.74
5	28	1.6	612	216	63	2.9	1690	2820	39	4.7	21	.54
6	43	2.3	271	75	72	3.1	2080	3600	72	7.6	13	.42
7	40	2.3	45	10	59	1.8	2950	5220	125	17	13	.39
8	40	2.4	32	7.2	31	.74	1890	3660	99	19	17	.41
9	29	1.6	19	3.6	36	.80	1700	3400	77	11	447	75
10	41	2.3	35	5.9	59	1.2	2650	5150	46	6.1	694	187
11	42	2.4	35	5.3	61	1.2	1700	3300	46	5.5	395	256
12	43	3.9	93	26	36	.62	1770	3420	51	6.3	2110	6840
13	1300	2010	56	13	37	.49	1900	3690	62	8.4	1580	2080
14	2340	4030	36	5.0	107	1.5	1740	3360	42	6.2	1660	2430
15	2010	3360	37	4.4	58	2.5	1830	3450	55	6.5	1810	2760
16	2220	3710	28	4.0	23	1.1	2940	5600	1110	797	3030	5680
17	1960	3390	30	4.4	20	.41	2160	4200	453	131	5950	6670
18	2050	3760	34	5.9	16	.20	1690	3280	40	5.3	4220	2460
19	2010	3640	156	56	22	.28	1610	3110	55	4.0	3310	1510
20	2000	3630	402	106	35	.44	1800	3450	36	3.0	2470	934
21	1840	3440	366	63	21	.23	1620	3170	35	2.4	742	228
22	1800	3350	330	47	19	.21	2410	4750	574	54	435	109
23	1800	3490	226	24	277	163	1960	3970	137	12	259	57
24	1880	3640	66	5.5	3550	4020	1590	3050	51	2.6	138	25
25	1790	3540	45	3.6	2890	3800	1810	3370	57	1.8	162	33
26	1790	3910	40	3.1	2460	3480	1570	2970	34	1.0	338	114
27	1800	3860	75	5.7	2010	2930	1650	3070	26	.98	930	1090
28	1660	3200	51	3.7	1950	2880	1510	2790	36	1.2	1230	1190
29	1800	3570	46	3.0	2050	3160	1430	2820	22	.57	838	532
30	1820	3630	49	3.2	1900	3050	1300	2280	24	.71	435	203
31	---	---	60	4.4	---	---	1430	2110	36	1.1	---	---
TOTAL	---	63183.59	---	2868.9	---	23516.72	---	108480	---	1564.96	---	35470.20

TOTAL LOAD FOR YEAR: 296889.06 TONS.

Geoscience
Consultants, Ltd.

February 25, 1985

Mr. Richard Stamets
NMOCD
P.O. Box 2088
Santa Fe, New Mexico 87501

Re: Effluent Flow and Chemical Characteristics of Waste Streams
Regulated by Discharge Plan

Dear Mr. Stamets:

Navajo Refining Company, Inc. and Geoscience Consultants, Ltd. are pleased to submit our report on effluent characteristics. Our previous submission described the process at the Artesia Refinery and presented chemical data on many individual waste streams. Section 1.0-6.0 of the Discharge Plan also presented chemical analyses of the evaporation pond fluids which represent the best composite sample of the effluent streams.

In the initial meeting of September 17, 1984 it was decided that all waste streams which are disposed of in the evaporation ponds would be governed by this Discharge Plan. These streams are:

- o Effluent from the oil/water separator
- o Effluent from the water softener
- o Boiler blow down
- o Effluent from the oil recovery system
- o Liquid effluent from the heat exchanger bundle cleaning area
- o Other liquid effluent which may be periodically discharged into the conveyance ditch

The chemical data on these waste streams were presented in Sections 1.0-6.0 of the Discharge Plan and are presented with this submission. Note that samples from the evaporation ponds were analised for benzene, toluene, xylene and ethylbenzene. Analyses of individual waste streams were included for information only. Regulatory decisions should consider the quality of the final effluent as characterized by analyses of the effluent flowing to the evaporation ponds.

The flow data is shown in the Table. At the present time no data are available for flow rates at the downstream end of the ditch.

500 Copper Avenue N.W. Suite 220, Albuquerque, New Mexico 87102 (505) 842-0001

If you or your technical staff have any questions about this submission please contact me at our Albuquerque office.

Sincerely,
GEOSCIENCE CONSULTANTS, LTD.

Randy J. Hicks PJ
Randall T. Hicks
Vice President

RTH/mg

cc: Mr. Dave Griffin, Navajo
Mr. Joel Carson, Losee, Carson, Dickerson
M. David Boyer, NMOCD (2 copies)

EFFLUENT FLOW DATA

DATE	GPD	PH
6-6-84	342,720	12.0
6-7-84	361,440	12.5
6-8-84	361,440	11.0
6-9-84	361,440	13.0
6-11-84	361,440	12.0
6-12-84	Cleaning ditch north of the FCC	13.5
6-13-84	303,384	11.0
6-14-84	342,720	13.0
6-15-84	342,720	13.5
6-18-84	342,720	9.5
6-20-83	361,440	9.0
6-21-84	342,720	9.0
6-22-84	342,720	10.0
6-23-84	381,440	9.5
6-25-84	361,440	8.5
6-26-84	342,720	9.0
6-27-84	419,040	9.5
6-28-84	380,160	10.5
6-29-84	361,440	11.0
6-30-84	380,160	11.5
7-2-84	342,720	12.5
7-3-84	342,720	10.0
7-5-84	342,720	9.5
7-6-84	380,160	9.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
7-8-84	361,440	9.5
7-10-84	361,440	9.0
7-11-84	342,720	10.0
7-12-84	303,840	10.5
7-15-84	342,720	8.5
7-19-84	380,160	7.5
7-20-84	380,160	9.5
7-23-84	380,160	12.5
7-24-84	361,440	11.0
7-25-84	380,160	12.5
7-27-81	380,160	11.0
7-30-84	361,440	9.0
8-2-84	342,720	9.0
8-3-84	380,160	9.0
8-6-84	342,720	9.0
8-7-84	342,270	10.0
8-8-84	361,440	11.0
8-9-84	361,440	9.0
8-14-84	380,160	8.0
8-15-84	380,160	8.5
8-16-84	419,040	8.0
8-17-84	380,160	8.0
8-20-84	380,160	7.5
8-21-84	380,160	7.5
8-22-84	380,160	8.0

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
8-23-84	380,160	10.0
8-24-84	361,440	9.0
8-27-84	361,440	9.5
8-28-84	380,160	8.5
8-29-84	361,440	10.0
8-30-84	380,160	8.0
8-31-84	380,160	7.5
9-5-84	380,160	7.0
9-6-84	380,160	8.0
9-7-84	380,160	8.0
9-10-84	380,160	8.5
9-11-84	361,440	9.5
9-12-84	380,160	11.0
9-13-84	380,160	9.5
9-14-84	361,440	11.0
9-17-84	342,720	11.5
9-18-84	361,440	9.0
9-19-84	380,160	7.0
9-20-84	361,440	9.0
9-21-84	342,720	9.0
9-24-84	342,720	8.5
9-25-84	361,440	8.5
9-26-84	342,720	10.5
9-27-84	342,720	11.0
10-1-84	361,440	10.0
10-2-84	342,720	9.5

EFFLUENF FLOW DATA CONT.

DATE	GPD	PH
10-3-84	361,440	10.5
10-4-84	342,720	11.0
10-5-84	342,720	10.0
10-8-84	361,440	8.0
10-9-84	342,720	9.5
10-11-84	342,720	10.5
10-12-84	342,720	10.0
10-15-84	361,440	11.5
10-16-84	419,040	7.5
10-17-84	398,880	8.5
10-18-84	398,880	7.5
10-19-84	419,040	7.5
10-22-84	398,880	10.5
10-23-84	419,040	8.5
10-24-84	419,040	7.0
10-25-84	398,880	9.0
10-26-84	398,880	11.0
10-29-84	419,040	8.0
10-30-84	398,880	9.5
10-31-84	398,880	9.0
11-1-84	398,880	6.0
11-2-84	342,720	8.0
11-5-84	380,160	5.5
11-6-84	303,384	4.0
11-7-84	303,384	7.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
11-8-84	380,160	8.5
11-9-84	380,160	7.0
11-10-84	342,720	8.0
11-11-84	342,720	9.5
11-12-84	380,160	9.0
11-13-84	342,720	8.5
11-14-84	303,840	8.5
11-20-84	380,160	7.0
11-21-84	380,160	9.0
11-22-84	342,720	10.0
11-23-84	342,720	9.0
11-26-84	380,160	8.5
11-27-84	398,880	10.0
11-28-84	419,040	10.5
11-29-84	419,040	8.0
11-30-84	380,160	10.0
12-3-84	398,880	11.5
12-4-84	398,880	10.5
12-5-84	380,160	13.0
12-6-84	419,040	9.0
12-7-84	398,880	8.0
12-10-84	380,160	6.5
12-11-84	419,040	11.5
12-12-84	398,880	9.0
12-13-84	419,040	9.0

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
12-14-84	398,880	9.5
12-17-84	380,160	6.0
12-18-84	342,720	7.5
12-19-84	419,040	8.0
12-20-84	380,160	11.5
12-21-84	380,160	10.0
12-26-84	342,720	9.0
12-27-84	342,720	11.0
1-2-85	380,160	9.5
1-3-85	361,440	6.0
1-4-85	361,440	8.8
1-7-85	342,720	9.5
1-8-85	303,384	10.5
1-9-85	342,720	10.0
1-10-85	342,720	12.0
1-11-85	303,384	9.0
1-14-85	342,720	10.0
1-15-85	303,384	8.5
1-16-85	380,160	6.5
1-17-85	342,720	7.5
1-18-85	361,440	8.5
1-21-85	361,440	7.0
1-22-85	342,720	7.0
1-23-85	342,720	8.0
1-24-85	419,040	6.5

EFFLUENT FLOW DATA CONT.

DATE	GPD	PH
1-25-85	361,440	7.5
1-28-85	380,160	7.0
1-29-85	380,160	7.0
1-30-85	361,440	6.0
1-31-85	342,720	7.5
2-1-85	361,440	8.5
2-4-85	342,720	7.0
2-5-85	242,720	9.0
2-6-85	361,440	9.5

TABLE 5-2
CHEMICAL ANALYSES OF SELECTED WASTE
STREAMS AT NAVAJO REFINERY (AFTER BRANVOLD, 1984)
(VALUES IN MG/L EXCEPT WHERE NOTED)

WQCC 3-103 STANDARDS	CRUDE UNIT PROCESS (#4, #11, #13)	CAT. CRACKER PROCESS BEFORE SOUR WATER STRIPPER	SOUR WATER STRIPPER EFFLUENT (#17)	ALKY. NEUTRALIZING SEWER (#6)	NO & SO DESALTERS (#3, #9)
As					
Ba					
Cd					
Cr	<0.1	<0.1	<0.1	7.8	
CN	<0.1	<0.1	<0.1	<0.1	<1.0
F	1.3	0.5	0.4	10.8	
Pb					
Hg					
NO_3					
Se					
Ag					
U					
Cl					
Cu					
Fe	<0.1	3.9	17.0	7.8	
Mn					
SO^4					
TDS	805	2160	560	2872	2524
Zn	<0.1	<0.1	0.12	18.8	
pH	6.3	9.0	9.5	3.6	
Al					
B					
Co					
Mo					
Ni					
Phenols	9.9	710	250	0.26	
TSS					
Cond.					
COD	1202	8379	1702	8870	600
NH_4	78	2320	256	<1	5.0
S	64	180	7.7	1.4	<1.0

Table 5-2 (continued)

BOILERS

WQCC 3-103	S.D.	N.D.	N.D.
PARAMETERS	BOILER BLOWDOWN (#2)	HIGH PRESSURE BOILER (#18)	LOW PRESSURE BOILER (#12)
As	.004	.005	.003
Ba	<.1	<.1	<.1
Cd	<.01	<.01	<.01
Cr	<.05	<.05	<.05
CN			
F	3.1	2.2	1.5
Pb	.18	.14	.05
Hg			
NO_3	.2	.1	.05
Se			
Ag	<.05	<.05	<.05
U	<.05	<.05	<.05
Cl	127	73	44
Cu	<.03	<.03	<.03
Fe	1.9	0.65	0.25
Mn	.07	<.03	<.03
SO	1549	1242	693
TDS	4220	2873	1807
Zn	.06	<.01	<.01
pH	11.6	11.6	11.2
Al	<1.0	<1.0	<1.0
B			
Co	<.01	.02	.01
Mo	<.5	<.5	<.5
Ni	<.05	<.05	<.05
Phenols			
TSS	20	0	0
Cond.	6000	5000	2800
COD	116	0	0
NH_4			
S			

Table 5-2 (continued)

COOLING TOWERS

	WQCC 3-103 STANDARDS	N.D. COOLING TOWER BLOWDOWN (#10)	S.D. ALKY COOLING TOWER BLOWDOWN (#1)	S.D. TCC COOLING TOWER BLOWDOWN	N.D. FCC COOLING TOWER BLOWDOWN (#16)
As		.004	<.001	.011	.001
Ba		<.1	<.1	<.1	<.1
Cd		<.01	<.01	<.01	<.01
Cr		.06	1.05	<.05	0.22
CN					
F		1.6	4.4	2.2	1.6
Pb		.05	.05	<.05	.05
Hg					
NO_3		.5	.75	.2	.3
Se					
Ag		<.05	<.05	<.05	<.05
U		<.05	<.05	<.05	<.05
Cl		48	53	44	47
Cu		<.03	<.03	<.03	<.03
Fe		.05	.5	<.05	<.05
Mn		<.03	.07	<.03	<.03
SO		1077	1461	1236	1067
TDS*		1906	2732	1694	1973
Zn		.48	28	<.01	.17
pH		7.6	6.9	7.7	8.0
Al		<1.0	<1.0	1.0	<1.0
B					
Co		<.01	.01	.02	.01
Mo		<.5	<.5	<.5	<.5
Ni		<.05	<.07	<.05	<.05
Phenols					
TSS		13	0	67	0
Cond.		0	0	108	1800
COD		1850			15
NH_4		0			

QUALITY OF WATER IN EVAPORATION PONDS

ASSAIGAI

ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

SAMPLE ID/ANALYTICAL RESULTS

ANALYTE	Pond #1 floating film	NOMINAL DETECTION LIMIT
NO_3 as N		0.01 mg/l
NH_4		0.1 mg/l
CN		0.01 mg/l
Benzene	0.617 mg/l	0.005 mg/l
Toluene	0.467 mg/l	0.005 mg/l
Xylenes	0.463 mg/l	0.005 mg/l
Ethylbenzene	0.201 mg/l	0.005 mg/l

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y., 1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

CUSTOMER Navajo Refining Co[illegible]ay
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo West Pond	Acidity		13
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium		0.2
	Biochemical Oxygen Demand		116
	Cadmium		0.003
	Chemical Oxygen Demand		102
	Chloride		918
	Chromium		0.04
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		6.6
	Hardness (as $CaCO_3$)		760
	Iron		0.06
	Lead		0.002
	Magnesium		60
	Nickel		0.01
	pH Units		7.7
	Phenols		0.04
	Alkalinity, "M"		173
	Solids, Total Dissolved		2930
	Sulfate		885
	Sulfide		25.1
	Zinc	<	0.1

10d

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

CEC

APPROVED BY [signature]

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.

REPORT OF ANALYSIS

CUSTOMER Navajo Refining Con y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Middle Pond	Acidity		29
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		116
	Cadmium		0.002
	Chemical Oxygen Demand		363
	Chloride		1468
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		7.4
	Hardness (as $CaCO_3$)		1060
	Iron		0.06
	Lead	<	0.001
	Magnesium		96
	Nickel	<	0.01
	pH Units		7.4
	Phenols		0.027
	Alkalinity, "M"		349
	Solids, Total Dissolved		4020
	Sulfate		1050
	Sulfide		13.4
	Zinc	<	0.1

140

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

CEC

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution Inc.

CUSTOMER Navajo Refining Com y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo East Pond	Acidity		10
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		72
	Cadmium		0.002
	Chemical Oxygen Demand		225
	Chloride		1632
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper		0.002
	Fluoride		5.8
	Hardness (as $CaCO_3$)		1160
	Iron		0.1
	Lead	<	0.001
	Magnesium		110
	Nickel	<	0.01
	pH Units		7.2
	Phenols	<	0.001
	Alkalinity, "M"		214
	Solids, Total Dissolved		4920
	Sulfate		1520
	Sulfide		0.36
	Zinc	<	0.1

10¢

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

CEC

Controls for Environmental Pollution, Inc.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

February 7, 1985

TONEY ANAYA
GOVERNOR

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-5800

CERTIFIED MAIL -
RETURN RECEIPT REQUESTED

Mr. Randall T. Hicks,
Vice President
Geoscience Consultants, Ltd.
500 Copper Avenue, N.W.
Suite 220
Albuquerque, New Mexico 87102

Re: Ground Water Discharge Plan (GW-28) for Navajo Refinery, Artesia

Dear Mr. Hicks:

The New Mexico Oil Conservation Division Environmental Bureau has reviewed your December 7, 1984, discharge plan submittal for the Navajo Refinery. We have some comments and questions on the material submitted and requests for additional clarifying information. Also, in a meeting with you on January 24, 1985, several substantial issues regarding discharge plan coverage and future work efforts were raised. I will discuss these issues first and then provide our specific comments on the material submitted.

Discharge Plan Issues

1. During the meeting of January 24, 1985, the hydrocarbon product recovery system and its relationship to the ground water discharge plan was discussed. You requested that the issues remain separate except that water discharges from the recovery system to the conveyance ditch would be covered under the discharge plan. We are agreeable to your request to cover the product recovery system under WQCC Section 1-203 instead of WQCC Part 3 Regulations. However, such approval is contingent on your written assurance that you will comply with the provisions of Section 1-203.A., and your agreement that the existing compliance schedule or approval of the discharge plan will not exempt you from Section 1-203. If agreed to, use of Section 1-203 will be limited to past petroleum product discharges; action to be taken to

protect ground water in the event of future spills must be covered in the discharge plan.

2. The WQCC Regulations do not provide exemptions for discharges covered under the RCRA regulations. Therefore continuing discharges of RCRA-regulated effluent or leachate (such as to the land farming area) are also subject to the WQCC Regulations. If the RCRA land-farm disposal system is performing as designed to protect ground water from heavy metals and toxic organics, it is also likely to be protecting ground water from degradation by non-RCRA contaminants such as chlorides, sulfates and total dissolved solids regulated under WQCC rules. To demonstrate this Navajo must submit sufficient technical information on frequency of application, quantities, total volumes, conditions of application, monitoring currently performed, etc. This information will be reviewed for WQCC adequacy. If needed, additional analyses of samples for some key WQCC constituents may have to be performed as part of the discharge plan. Similar information also should be submitted for any RCRA approved site currently receiving discharges.

3. Demonstration that continued use of the 3-mile unlined conveyance ditch does not provide a hazard to ground water will be very difficult. This ditch transfers all refinery wastewater to the evaporation ponds, contains levels of benzene and other constituents in excess of WQCC standards (as evidenced by pond levels exceeding these standards), and contains other pollutants discharged from the oil-water separators. Information provided in the discharge plan indicates that a very shallow aquifer exists at depths betwen 15 and 30 feet beneath the refinery. At a specific conductance of about 2500 umhos/cm (Appendix B), the quality of this so-called "perched" aquifer is good and apparently has provided water for stock (p. 4-11). The potentiometic map (Figure 4-7) shows water movement to the east toward the river. The same geologic conditions and shallow useable ground water are likely to occur in the area of the ditch until the Pecos Valley alluvium is reached. This water must be protected from any ditch discharges that would cause exceedance of ground water standards. The contention (p. 6-2) that the ditch is self-lined due to deposition of asphaltic material has not been demonstrated and no information

on ground water quality along the ditch has been provided. Even if several monitoring wells along the 3-mile length showed no contamination, this would not be assurance that contamination is not occurring in between the monitoring points. The ditch is a possible line source of recharge and investigation of specific hydrologic conditions along its entire length would be time-consuming, expensive, and very possibly inconclusive. Navajo is strongly encouraged to look at other alternatives to the unlined ditch for transfer of effluent to the ponds.

4. Navajo should continue the hydrogelogic studies it is conducting in the vicinity of the evaporation ponds. Alternatives other than pond lining are available for discharge plan approval under Section 3-109.C. of the Regulations.

Specific Comments/Questions

HYDROGEOLOGY:

1. Are wells numbered 45, 46, and 47 the waste conveyance monitor wells referred to on p. 3-1?

2. Provide a table listing available information (location, owner, date drilled, depth, aquifer or water bearing zone, water level, date measured, use, etc.) for all water wells (except those drilled by Navajo) within one mile of the refinery property, one mile either side of the conveyance ditch, and within one mile of the evaporation ponds (on both sides of the river).

3. A statement on p. 4-1 asserts that Pecos Valley alluvium is not used for any purpose in "this area." What is the extent of the referenced area and what is the source of water for the windmill in the NW/4, SW/4 of Section 12, Township 17 South, Range 26 East, and the water well listed on Figure 4-9?

4. What is the source of information for the geologic map shown in Figure 4-1?

5. Provide a legible copy of Figure 4-2 and provide units for permeability and other listed soil characteristics.

6. Clarify whether the depth to the top of the Queen formation is 150 or 200 feet (p. 4-10).

7. The depth and aquifer designation for well 6612 is incorrectly drawn on Figure 4-3.

8. Describe the characteristics and extent of the Bower Sand shown on Figure 4-3. This sand was not discussed in the discharge plan submittal.

9. Several of the well records in Appendix A from the State Engineer's Office have critical information that is illegible. Provide legible logs or tabulate the critical information (eg. depth of well, depth to water upon completion, major water-bearing strata, etc.).

10. Logs for Navajo wells #2, 4 to 8, 10 and 11, 14 and 15, A to J, and the product recovery wells are missing. Provide the logs if available or a narrative on construction information, date, depth, use, etc.

11. The photocopies of the sample log for wells AA through AI, and R through T are illegible in part. Provide legible log copies.

12. What is the source of the apparent artesian head in the perched water unit and shown in Figure 4-6? Do all monitor wells near the refinery exhibit these apparent artesian conditions?

13. Is there any apparent source of recharge or discharge (pumping) that could account for the potentiometric anomalies described on p. 4-12 for wells #19 and 34 and 29, 37, 39 and 40?

14. What is the hydrologic relationship of Eagle Draw to the perched shallow artesian zone?

15. Provide the conductance vs. discharge vs. relationship for the Pecos River near Artesia for October through April 1982 and 1983.

16. The potentiometric surface map at the evaporation ponds (Figure 4-9) shows ground water levels several feet above river elevations. Water movement to the north or south could be inferred from differences in these elevations. The time of year the measurements

were made was omitted from the figure. To determine what the actual situation is and verify the accuracy of the statement on p. 4-14 that the gradient is reversed at low flow, additional shallow subsurface information needs to be obtained. This should include comparison of seasonal water levels in the river with those in the pond monitoring wells. Frequent water level measurements by hand or through use of a water level recorder may be needed to make this determination. Seepage from the ponds producing a ground water mound may also contribute to high water levels in pond monitor wells.

17. Figure 4-9 shows water levels to be higher in pond 3 than in upstream pond 2. If the dike(s) has been breached, why are the levels unequal?

18. Is Navajo's property boundary given by the heavy black line in Figure 4-9? If so, provide the names and show the locations of the property owners immediately adjacent to the ponds.

19. Regarding the conveyance ditch, does Navajo own the ditch or have an easement? If an easement, provide the name and location of the property owners.

20. Provide a map showing the current 100-year flood plain at the refinery and the maximum 100-year flooding that could occur after the city makes changes in the Eagle Creek drainage. Indicate the status and proposed completion date of the flood control efforts (eg. planning only, money allocated, under construction).

21. Figure 4-9 shows that dike levels at the ponds are 10 to 14 feet above the river rather than the 16 to 18 feet given on p. 4-15. Clarify this discrepancy.

22. On Figure 4-9, where is monitoring well #16 located? What are its completion details?

23. Provide the 100-year flood plan map in the vicinity of the end of the conveyance ditch and the ponds. Show on the map the 1932 flood stage of 17.4 feet and the 13.76 feet stage of 1954. Show the extent and frequency of the largest discharge expected under controlled discharge conditions. What precautions have been taken to protect the conveyance ditch and ponds from such releases?

WATER QUALITY:

1. Provide a summary of water quality characteristics of the San Andres and upper Queen aquifers in the refinery area.

2. Contrary to the statement on p.4-16, the water quality in the Pecos River Valley alluvial sand/silt aquifer has not yet been sufficiently characterized by Navajo. Background quality cannot be defined until seasonal variations, and ground water flow direction(s) are known. Since pond seepage appears to have affected some close monitoring wells, analyses of water samples from those wells would not be representative of the back- ground water quality.

3. Analyses of the Pecos River up and downstream of the ponds and at low flow should be made to characterize river quality and any effect of pond seepage on NM Stream Standards.

4. Which "well water" is referred to in the 4/30/81 CEP Analysis labeled "Page 1 of 13 pages?" Where is this well located? What are its depth and completion details? From what zone is it producing?

5. On page 4-17, the statement is made that direct contamination of ground water at the refinery is unlikely due to the presence of artesian conditions and that contamination could be occurring due to contact between artesian water in the wellbore and hydrocarbons in the soil. While we believe this could be true for some individual wells, the presence of floating product up to several feet in thickness in at least ten of the wells, as shown in drilling logs, shows that product has indeed moved downward despite apparent artesian conditions. There is also the possibility that the artesian conditions are recent and localized, and contamination predated a rise in water levels and pressures to current elevations. This statement needs to be revised to reflect actual conditions.

6. The last paragraph of page 4-17 asserts that the ground water of the shallow, perched-water unit is 1) of limited extent, 2) not utilized by any off-site wells, and 3) not connected with any other aquifer. Navajo has not conclusively demonstrated the correctness of these assertions (see issue 3 above).

Even if the situation is as Navajo suggests, this ground water is to be protected for present and potential future use since it can be used as a water supply and has an existing concentration much less than 10,000 mg/l TDS.

7. Provide TOC, Chloride, Sodium, and sulfate data for the TEL and colony areas (see Appendix B).

8. Although Navajo will provide additional effluent flow and quality characterization in the February 25, 1985 submittal, the following deficiencies were found in the December 7, 1984, submittal:

   (a) Where were effluent rates measured? Flow measurements need to be made at the beginning and end of the ditch.

   (b) No analysis was provided for waste stream #14 (Desulfurizers).

   (c) Table 5-2 does not provide analyses for benezene, toluene, ethylbenzene, xylenes, or the other WQCC organic standards. The presence or likelihood of toxic pollutants has not been discussed.

PLANT PROCESSES:

1. Are injection wells used for disposal of any produced water or any refinery generated wastewater?

2. In addition to the information provided in Section 5.3.1., provide additional information on the fire pond. Include engineering information (size, depth, volume, liner, discharge rates in and out), range of TDS and flow variation from individual boilers, and use of additives (chromates, phosphates, organics, etc). Provide information on uncontaminated ground water quality in the pond vicinity.

3. Discuss the TEL pond, its use, dates of use, type of effluents, closure procedures, and if it is under a RCRA monitoring plan. This information will be useful in interpretation of the subsurface hydrologic data.

4. Provide construction details for the oil-water separators. Provide residence times prior to sludge removal, frequency of sludge removal, and residence time after removal.

5. Describe the blending operations, additivites used, and storage and drainage for this area.

6. In Table 5-2, indicate the type of chromium analysis performed. Is the analysis for CN listed in Table 5-2 for streams #3 and #9 in error?

7. Waste stream #18 is not on drawing 5-2 but an unnumbered waste stream is present on the drawing. Clarify the waste stream numbering.

8. Does Navajo have any underground storage tanks?

Please provide three copies of all future submittals (including maps and drawings), so that additional copies are available for field office use and public review. If you have any questions regarding these comments or the additional information requested, please contact me at the above address or by telephone at 827-5812.

Sincerely,

DAVID G. BOYER
Hydrogeologist

cc: OCD Artesia Field Office
NMEID Hazardous Waste Section
David Griffin, Navajo Refining Co.

● SENDER: Complete items 1, 2, 3, and 4. Add your address in the "RETURN TO" space on reverse.

(CONSULT POSTMASTER FOR FEES)

1. The following service is requested (check one).
☒ Show to whom and date delivered .... ¢
☐ Show to whom, date, and address of delivery.. ¢
2. ☐ RESTRICTED DELIVERY (The restricted delivery fee is charged in addition to the return receipt fee.) ¢

TOTAL $

3. ARTICLE ADDRESSED TO:
Mr. Randall T. Hicks
Geoscience Consultants, Ltd
500 Copper Ave. N.W.
87102

4. TYPE OF SERVICE: ☐ REGISTERED ☐ INSURED ☒ CERTIFIED ☐ COD ☐ EXPRESS MAIL

ARTICLE NUMBER P 505 905 848

(Always obtain signature of addressee or agent)

I have received the article described above.
SIGNATURE ☐ Addressee ☐ Authorized agent

5. DATE OF DELIVERY

POSTMARK FEB 1985

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P 505 905 848

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Street and No.: 500 Copper Ave N.W.

P.O., State and ZIP Code: Albq., N.M. 87102

Postage $

DISCHARGE PLAN
SECTIONS 1.0-6.0
NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO
REFINERY

Prepared for:

David Griffin
Navajo Refining Company
P.O. Drawer 159
Artesia, New Mexico 88210

December 3, 1984

Prepared by:

Geoscience Consultants, Ltd.
500 Copper Avenue
Suite 220
Albuquerque, New Mexico 87102

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APPENDICES

APPENDIX A   WELL LOGS

APPENDIX B   WATER QUALITY

1.0 EXECUTIVE SUMMARY

Navajo Refining Company, P.O. Drawer 159, Artesia, New Mexico, 88210 discharges approximately 405,200 gallons per day of oil refinery wastewater to evaporation ponds. The refinery is located in Section 9,T. 17S. R. 26 E. and the 85 acre evaporation ponds are located in Section 12,T.17 S, R. 26 E. Wastewater from the process units flows through an oil/water separator to remove the bulk of the hydrocarbons discharged with the wastewater. The refinery's effluent has a total dissolved solids content of 2000-4000 mg/l. The ground water near the evaporation ponds is at a depth of 8 feet with a background total dissolved solids content of about 15,000 mg/l. In the refinery area the "shallow aquifer" (upper Queen Formation), which is at a depth of 150 to 250 feet below land surface, exhibits nearly 100 feet of artesian head. The total dissolved solids content of the ground water in this aquifer is about 500-1000 mg/l. About 15 feet below land surface a 2 to 5 foot thick water-bearing unit is present in the Refinery area. This unit exhibits some artesian pressure and has a total dissolved solids content of about 1500 mg/l.

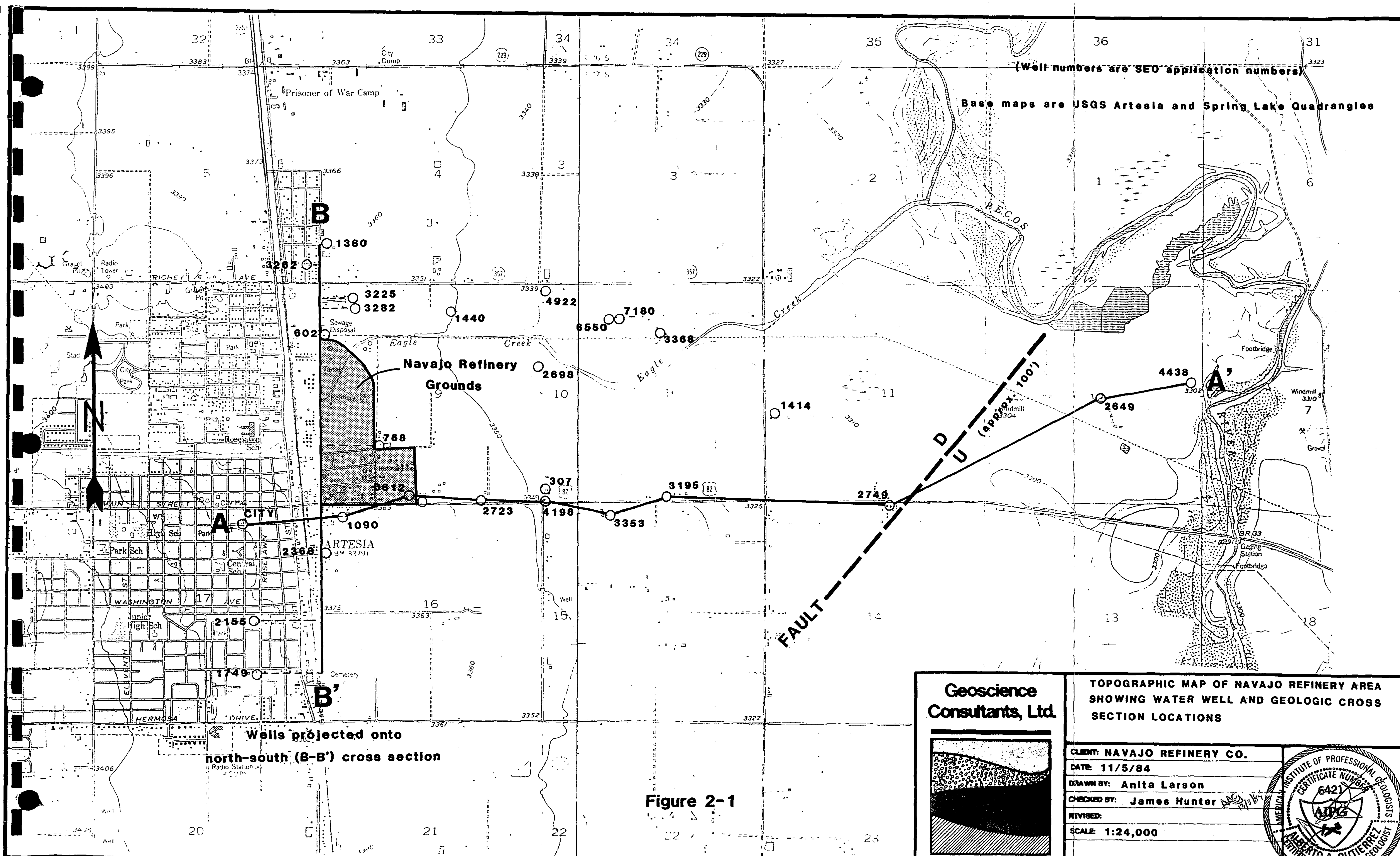
2.0 LOCATION AND PHYSIOGRAPHY

2.1 LOCATION

The Navajo Refining Company's plant facilities and wastewater management system are located in and near the town of Artesia, in Eddy County, New Mexico. The refinery's processing plant and much of the waste management system is located within the city limits, in the west 1/2 of Section 9, T. 17 S., R. 26 E. The associated wastewater evaporation facilities are located in Sections 1, 2, 9, 10, 11, and 12 of T. 16 S., R. 26 E., and in part of the west 1/2 of Section 6, T. 16 S., R. 27.E. (Figure 2-1).

2.2 PHYSIOGRAPHY

Artesia lies in the Eastern Plains of New Mexico; a broad, flat plateau with a local elevation of 3300 to 3400 feet above sea level. Topography in the Artesia area slopes gently (15 to 20 feet per mile) to the east, and is drained by the nearby Pecos River (Figure 2-1). The region is semiarid, with rainfall averaging less that 11 inches per year. Soils are typically of the Arno, Harkley, Pima and Karro associations, developed by deep weathering of bedrock or old alluvium (USSCS, 1971).



Geoscience Consultants, Ltd.

TOPOGRAPHIC MAP OF NAVAJO REFINERY AREA SHOWING WATER WELL AND GEOLOGIC CROSS SECTION LOCATIONS

CLIENT: NAVAJO REFINERY CO.
DATE: 11/5/84
DRAWN BY: Anita Larson
CHECKED BY: James Hunter
REVISED:
SCALE: 1:24,000

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3.0 BRIEF HISTORY OF OPERATION

The refinery began operations in the 1920's. The technology, size and ownership of the facility have changed numerous times since commencement of crude processing. Until 1969, the North Division and the South Division were operated by Conoco. Navajo then purchased both units and began to further integrate the operation into a single refinery capable of processing New Mexico sour crude (an asphalt-based crude with a high sulfur content) in the South Division and New Mexico intermediate crude (a paraffin-based crude produced mainly from the Abo Formation) in the smaller North Division.

Since the 1970's Navajo has constructed over 50 monitor wells and product-recovery wells to address the environmental concerns at the facility. The installation of four product-recovery trenches has resulted in a significant reduction in the total amount of hydrocarbons which exist in soil. Hydrocarbon product recovery will continue and, if necessary, be expanded to insure environmental protection.

Ground-water monitor wells are also in place throughout the refinery to assist in delineating soil contamination by hydrocarbons, for RCRA monitoring of landfarms and other RCRA disposal facilities, and to monitor the integrity of the waste conveyance and evaporation facilities.

In addition to ground water monitoring, Navajo maintains a strict manifest and record-keeping system. This system helps to insure that all waste is handled and disposed of properly. This system is in compliance with all applicable RCRA regulations.

4.0 DESCRIPTION OF PHYSICAL ENVIRONMENT AT SITE

Four water-bearing units are present beneath the Navajo Refining Company facility:

- o The San Andres Formation
- o The upper Queen Formation
- o Alluvium in the Pecos River Valley
- o Small, discontinuous perched-water aquifers in the Seven Rivers Formation

The San Andres and upper Queen formations are the principal aquifers of the Artesia area (Welder, 1983). The San Andres also locally called the deep or artesian aquifer has been extensively developed for industrial, municipal and agricultural purposes. This unit is under considerable artesian pressure. The upper Queen in the Artesia area is principally used for individual domestic wells, but some larger capacity wells completed in this unit are employed for irrigation. Unlike the "shallow" aquifer in the Roswell area, water-bearing sand units in the upper Queen exhibit artesian head. Adjacent to the Pecos River a third water-bearing unit is present: the Pecos River Valley alluvium. This unit is not currently utilized in this area for any purpose due to its poor water quality. Within the Seven Rivers Formation isolated permeable sands and fractured evaporites will produce small quantities of poor quality water. These isolated units may show a few feet of artesian head. One such unit is present about 15 feet below the Refinery. The evaporation ponds and portions of the conveyance ditch lie on the flood plain of the Pecos River and Eagle Draw. However, numerous flood control structures up stream from Navajo have eliminated most of the flooding potential of the facility.

4.1 GEOLOGY

The town of Artesia and the Navajo site are underlain by thin (20 feet or less) layer of soils, alluvium and weathered bedrock, which generally conceals subcrops of the Artesia Group (Permian). As seen in the explanation of figure 4-1, the Artesia Group consists of carbonates, evaporites and shales deposited in a backreef environment. The Artesia area is located on the northwestern shelf of the Permian Basin and basinward (south-easterly) stratigraphic dips of 1 to 3 degrees are typical.

Structure in the Artesia area is expressed as gentle (1-3 degree) southeasterly dips, with few other features. One fault (inferred from subsurface data) is mapped in the area. This fault trends about N. 40 E. through sections 11, 12 and 14 (Figure 4-1), and is apparently a normal fault with the northwest block downthrown. This structure parallels the other major structural elements of this area, such as the Y-O and K-M "buckles" or fault zones (Kelley, 1971).

In Section 12, the fault appears to pass beneath the Navajo Refining Company's evaporation ponds near the Pecos River.

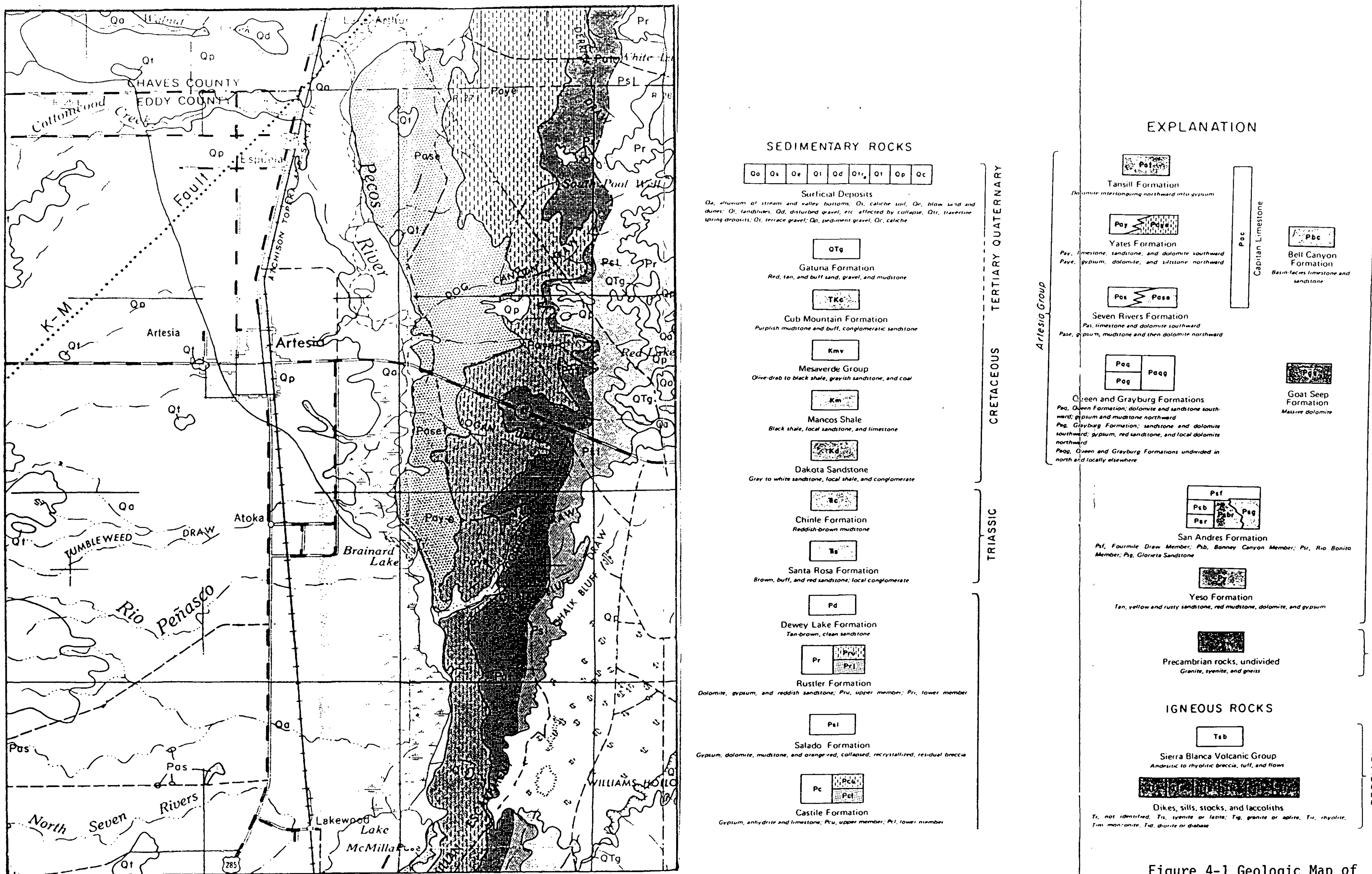


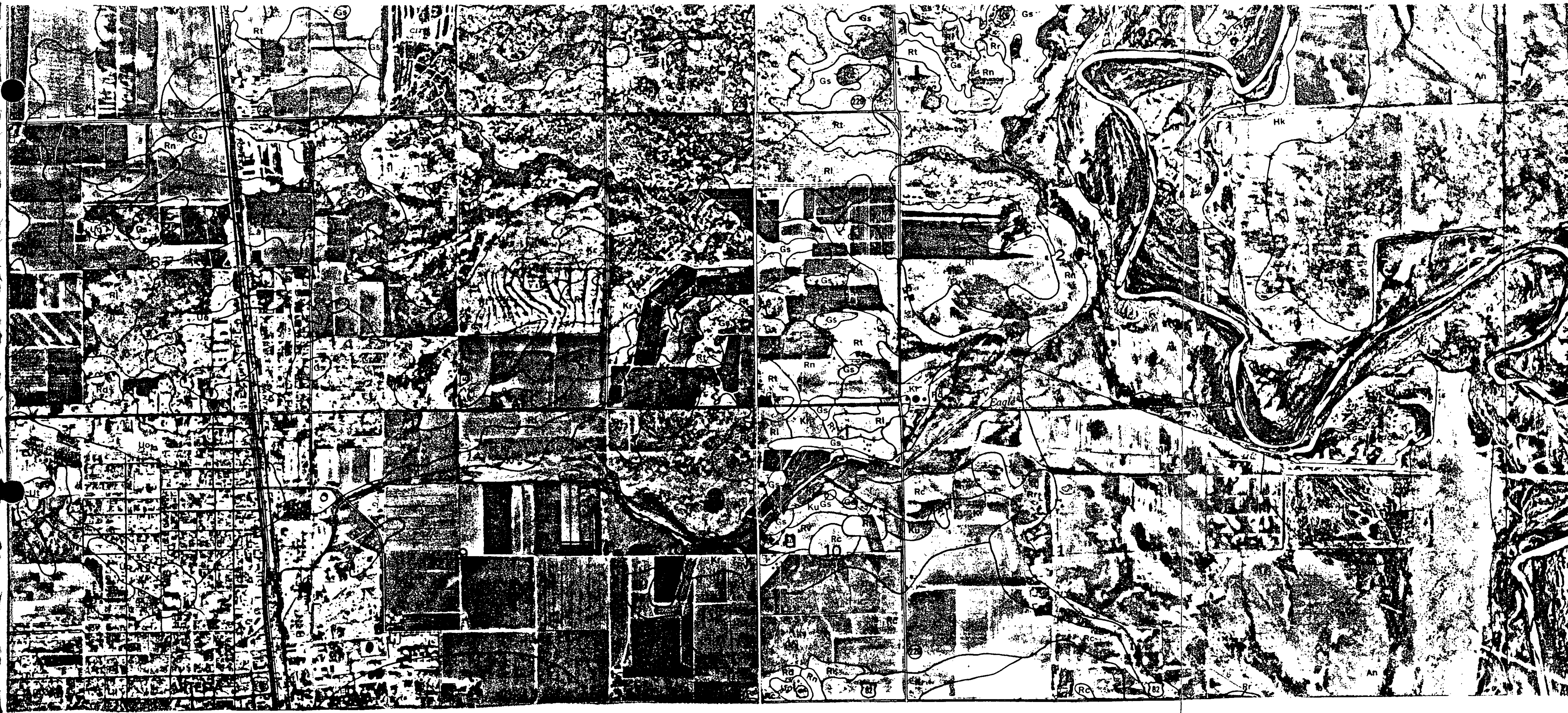
Figure 4-1 Geologic Map of Artesia area

Although the fault may cut across all known and potential aquifers, there are several reasons why the fault is not a potential conduit for ground water contamination. First, faults in evaporites (Queen, Seven Rivers) typically "heal" or self-seal by flowage and recrystallization of gypsum and anhydrite. Second, the net hydrostatic head of the shallow and deep artesian aquifers is upward and would prevent any downward flow.

4.2 GEOMORPHOLOGY AND SOILS

The Artesia region is located on a broad, gently sloping plateau which has developed as a result of in-situ weathering of flat-lying carbonate and evaporitic bedrock. Localized areas of valley fill (Pecos River Valley and major arroyos) form the only other significant substrate for soil formation. Within soil series formed on a particular substrate, soil properties vary as a result of differing grain size, land slope and available moisture. Figure 4-2 shows the distribution and properties of soil types in the Artesia area. The Navajo plant site is located in an area of Karro Loams (USSCS, 1971). These soils are developed on deeply weathered calcareous rocks, and are moderately permeable. Much of the refinery site area has been filled, graded and leveled, leaving little natural soil in place.

The effluent ditch (Figure 2-1) parallels Eagle Creek, and is constructed in soils of the Pima Series. These dark, calcareous loams develop on carbonate bedrock and carbonate-rich alluvial material. They are moderately permeable and have a high water-holding capacity.



Soil series and map symbols	Depth to bedrock, hard caliche, or gypsum	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO	Percentage passing sieve-: No. 4 (1.7 mm.)	Percentage passing sieve-: No. 10 (2.0 mm.)	Percentage passing sieve-: No. 200 (0.074 mm.)	Permea-bility	Available water capacity	Reaction	Electrical Conductivity (Ec x 10^3)	Corrosivity (Untreated Steel pipe)	Shrink-swell potential
Arno: AH, Ak, An (For Harkey part of AH and Ak, see Harkey series).	More than 60.	0-14	Silty clay loam	CL	A-6	100	100	90-95	0.05-0.20	0.18-0.20	7.9-8.4	4.0-8.4	High	Moderate
		14-60	Silty Clay	CH	A-7	100	100	90-95	0.05-0.20	0.15-0.17	7.9-8.4	8.0-12.0	High	High
Harkey: Ha, Hk	More than 60.	0-87	Very fine sandy Loam, Loam and silt loam.	ML	A-4	100	100	60-75	0.8-2.5	0.17-0.19	7.4-7.8	2.0-12.0	Moderate to high	Low
Karro: KA, KL, Kr, Ku, KV	More than 60.	0-20	Loam	ML-CL	A-4	100	100	60-75	0.8-2.5	0.16-0.18	7.9-8.4	4.0-10.0	High	Moderate
		24-60	Clay loam	CL	A-6	100	100	70-80	0.8-2.5	0.18-0.20	7.9-8.4	8.0-15.0	High	Moderate
Pima: PM, Pe, Pn, Pv	More than 60.	0-60	Silt loam to silty clay loam	CL	A-6	100	100	85-95	0.2-0.8	0.18-0.20	7.4-7.8	0-4.0	Moderate	Moderate

Figure 4-2 Characteristics and distribution of soils in Artesia area.

The evaporation ponds are built on soils of the Arno Series which develop on fine, silty alluvium in the Pecos River Valley. These soils have low permeability and high waterholding capacity.

4.3 REGIONAL HYDROGEOLOGY

The Artesia area is located in the Roswell-Artesia artesian water basin (Welder, 1983). The two principal ground water reservoirs are the artesian San Andres aquifer, and two shallow aquifers (Queen Formation and valley alluvium). Local, perched water-bearing units with small storage capacity also occur in isolated stratigraphic traps. With the exception of some wells located in valley alluvium immediately adjacent to the Pecos River, all wells in the Artesia area exhibit some degree of artesian head. Deep (800-1200 feet) artesian wells are completed in the Grayburg-San Andres formations, and have static water levels 50 to 80 feet below ground level. The deep aquifer is confined by shales and evaporites of the lower Queen Formation.

Shallow aquifer wells (150-250 feet) produce from the upper sands of the Queen Formation, and are confined by aquitards of anhydrite, gypsum and shale in the overlying Seven Rivers Formation (Figure 4-3). Water levels in shallow wells range from 40 to 60 feet below ground level.

Regionally, some wells tap the shallow, perched "gyp water" reservoirs in stratigraphic traps in the upper Seven Rivers Formation. These waters are effectively isolated from both major aquifers. Even in very shallow wells (20 feet) these perched zones exhibit 3 to 5 feet of artesian head.

The regional potentiometric surfaces of the deep and shallow aquifers are shown in figures 4-4 and 4-5. The two potentiometric surfaces have very similar elevations (about 3300' msl), with the deep artesian aquifer's surface slightly above the shallow aquifer's surface.

Both aquifers produce water for irrigation, industrial and domestic purposes. Water quality is variable from 500 to over 5000 ppm total dissolved solids, and in general the more saline waters are found at greater depths and/or to the east.

4.4 GROUND WATER HYDROGEOLOGY

The deep artesian aquifer is the major source of ground water in the Artesia area and supports most of the large local agricultural industry. Artesian water, of quality ranging from 500 to over 5000 ppm TDS, is found in the San Andres and Grayburg formations (Permian) at depths of 850 to 1250 feet below the surface (Kelley, 1971). This aquifer system is recharged along San Andres outcrops in the Sacramento Mountains west of Artesia. In the early 1900's many wells in this aquifer flowed 1000 to 3000 gallons per minute (gpm), but extensive withdrawals have lowered the head to about 50 to 80 feet below the land surface (Figure 4-4). The artesian aquifer is confined by the impermeable (or very slightly permeable) carbonates, shales and evaporites which comprise much of the overlying Queen and Seven Rivers formations (Figure 4-3). Its potentiometric surface is typically slightly above the shallow aquifer's upper surface (Welder, 1983).

The shallow aquifer, which has been described as a "water table" aquifer, is in fact a second artesian aquifer. With the

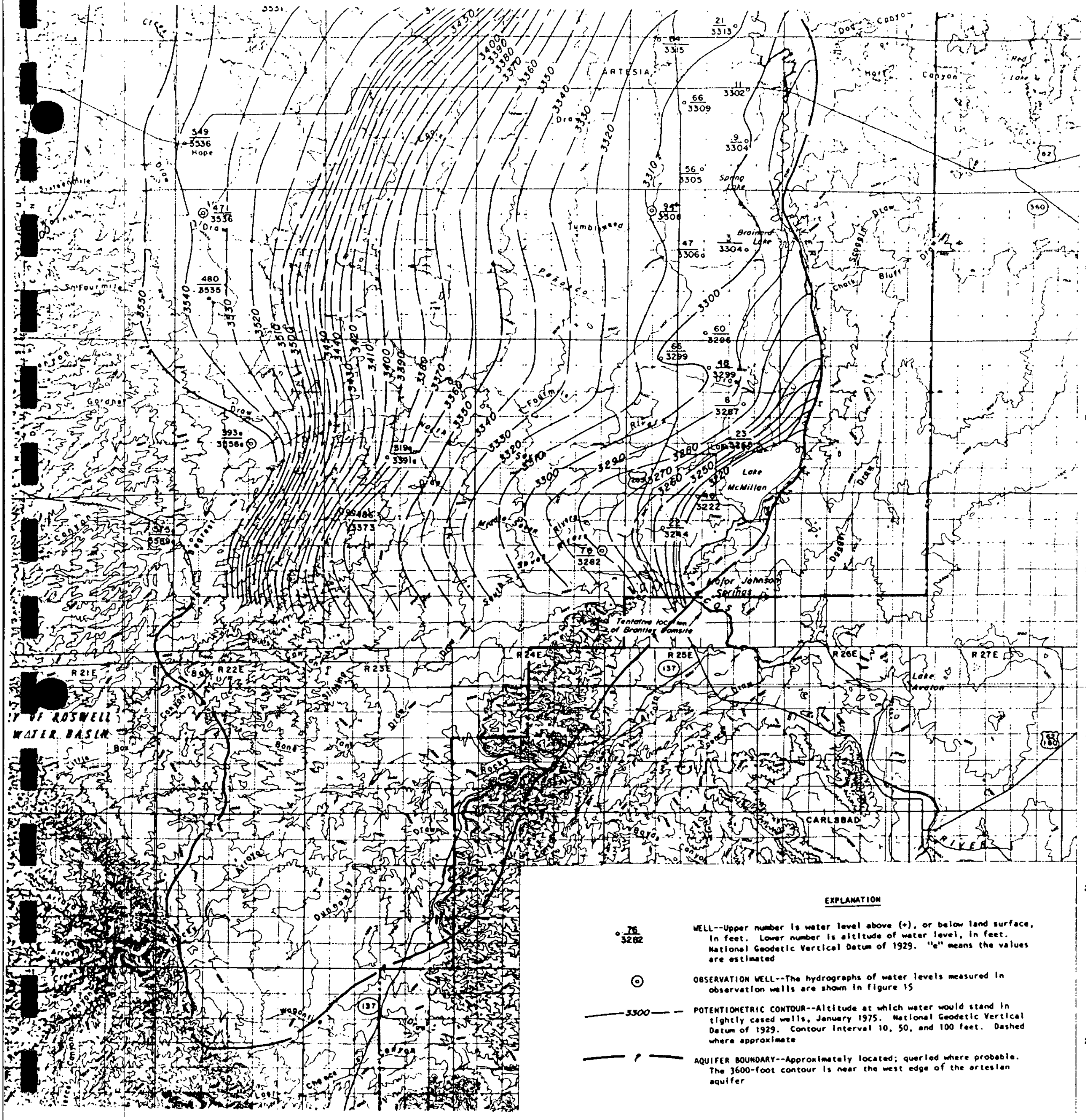


Figure 4-4 Potentiometric surface of deep aquifer (Welder, 1983)

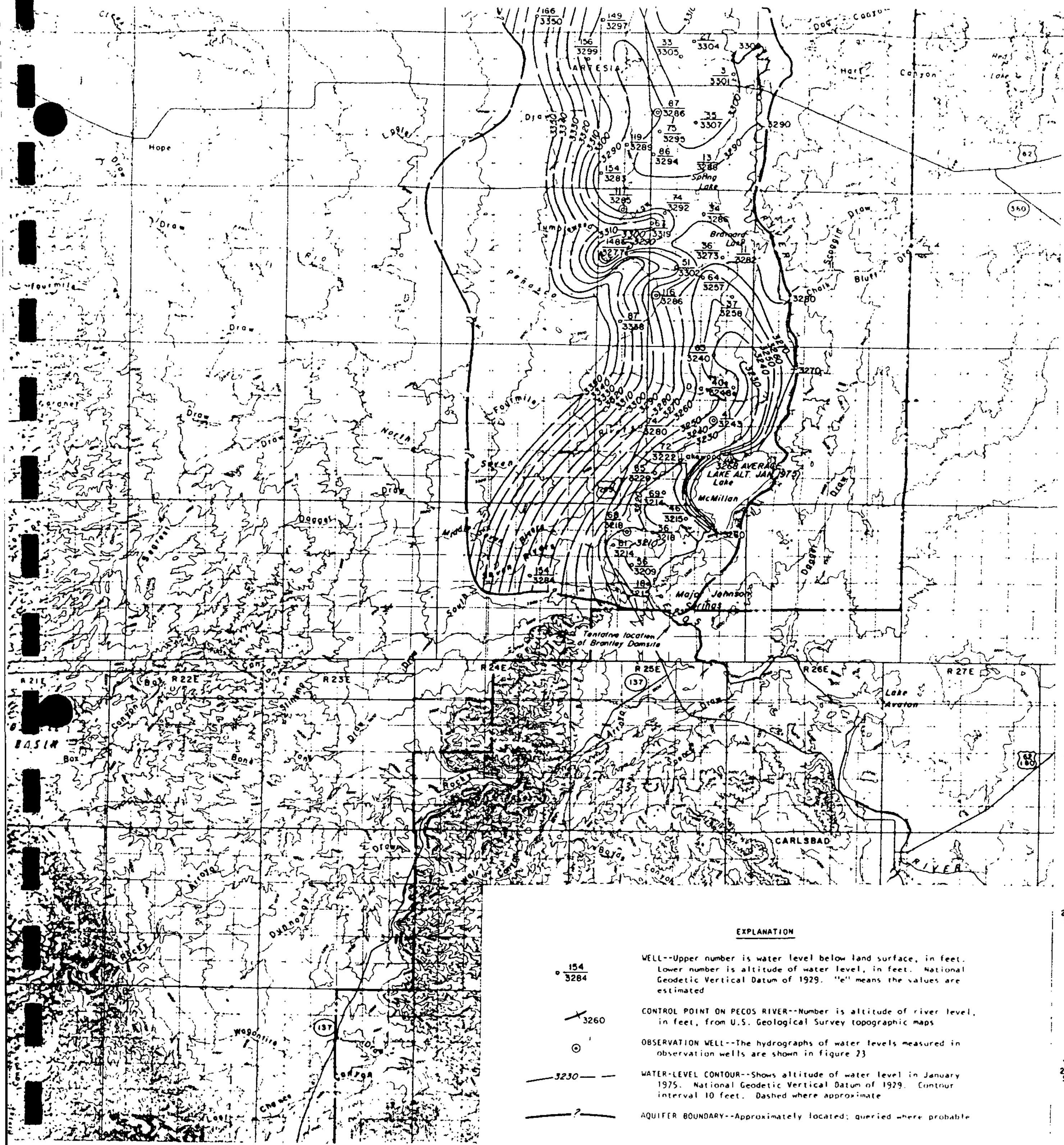


Figure 4-5 Potentiometric surface of shallow aquifer (Welder, 1983)

exception of wells drilled immediately adjacent to the Pecos River nearly all shallow-aquifer wells exhibit 100 to 150 feet of artesian head. Shallow wells typically produce from sands in the upper Queen Formation at depths of 150 to 250 feet. These sands are confined by the thick anhydrites and shales (aquitards) of the overlying Seven Rivers Formation. Relatively impermeable shales and evaporites several hundred feet thick separate the upper Queen sands from the underlying San Andres.

Analysis of driller's and geophysical logs (Appendix A) shows that the Navajo site is underlain by evaporites, carbonates and shales of the Seven Rivers Formation. These rocks are nearly impermeable, with the exception of local, isolated bodies of sand and fractured anhydrite. Only minor amounts of ground water is found in or produced from the Seven Rivers Formation. Cross sections illustrating the hydrogeologic relationships of the shallow aquifer are shown in Figure 4-3.

At depths of approximately 200 to 250 feet, the uppermost sands of the Queen Formation are encountered. These sands contain and produce usable amounts of ground water, and constitute most of the shallow aquifer in this area. These sands are 10 to 50 feet thick, and lie at the top of about 700 feet of relatively impermeable carbonates and evaporites which comprise the bulk of the Queen.

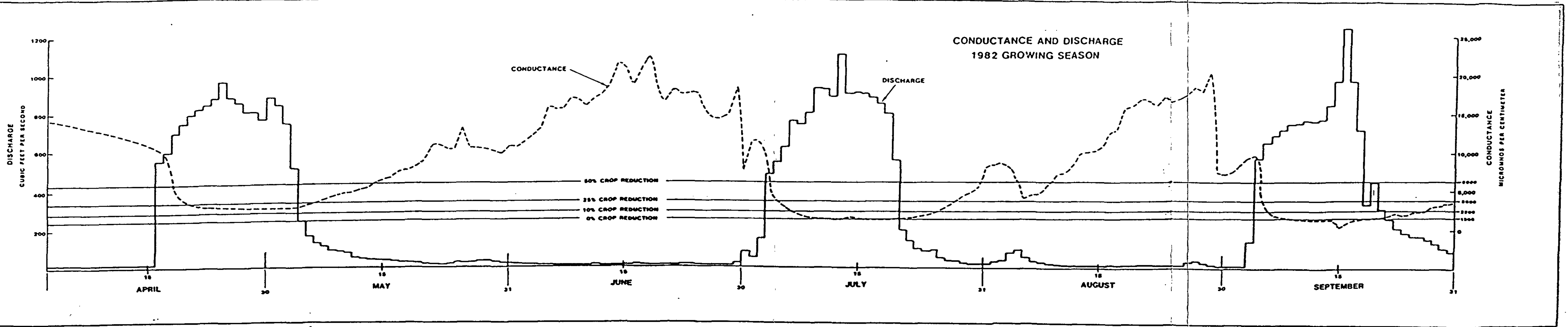
A map of the shallow-aquifer potentiometric surface (Figure 4-5) shows that it typically slopes gently to the east and southeast, and follows the regional stratigraphic dips. South of the Artesia area, where extensive agricultural development exists, the potentiometric surface forms a trough due to significant withdrawals from the shallow aquifer. The shallow-aquifer's potentiometric surface is generally slightly below the artesian aquifer's potentiometric surface, indicating that any interconnection (along faults or poorly completed wells) would cause flow upward from the deep to the shallow aquifer. The configuration of the shallow aquifer is locally complicated by large, seasonal irrigation withdrawals. Although considerable local variation is observed, the shallow aquifer generally provides water of quality adequate for domestic and irrigation use (500-1500 ppm TDS).

In some areas there is evidence for the existence of an isolated, discontinuous perched-water aquifer, which lies on top of clay or anhydrite lenses above the confined shallow aquifer. Very shallow (10-30 feet), low-production wells may have tapped this "gyp water" in the past and used the production for stock. Many of these wells have been abandoned for a variety of reasons including exhaustion of water or poor quality. These small, stratigraphically-trapped accumulations of ground water are highly variable in areal extent, volume, saturated thickness and quality. One such confined body of water underlies part of the Navajo facilities.

The configuration of the perched-water unit under the Navajo site is revealed by over 40 monitor wells, installed by Navajo Refining Company. Lithologic drillers logs show that water is encountered in weathered and fractured anhydrite (so called gypsum sand) at depths of 15 to 30 feet, and typically rises to levels 3 to 5 feet above the saturated unit (Appendix A). This water-bearing unit is confined above by layers of gypsum, anhydrite and caliche, and below by a continuous layers of clay and anhydrite. Figures 4-6 and 4-7 illustrate the geometry and hydrology of the plant site area.

These figures show that this perched gypsum/anhydrite/sand unit is comprised of several water-bearing zones at different depths. The water-bearing zones are generally less than 5 feet thick and are typically hydraulically connected. However, wells #19 and #34, and #29, #37, #39 and #40 show that anomalies in the potentiometric surface are present due to complex hydraulic connections in some areas of the plant.

Navajo Refining Company maintains 3 evaporation ponds near the Pecos River, which are connected to the plant site by a conveyance channel paralleling Eagle Creek (Figure 2-1). These ponds, and the portions of the conveyance channel in Sections 12, 11 and the E 1/2 of 10 are located in Pecos valley alluvium. Monitor wells installed by Navajo show that ground water in the valley alluvium is typically 6 to 12 feet below the surface. Although the alluvium is generally silty sand, some 6 inch monitor wells can maintain a pumping rate of 10-15 gpm indicating the presence of lenses of higher permeability material. Figure 4-8 shows the configuration of the water surface in this unit. As expected, flow is sub-parallel to the Pecos River Valley. The water level in this unit does respond to the fluctuations of flow in the River (Figure 4-8). Therefore, during periods of high flow the hydraulic gradient is from the river to the alluvium



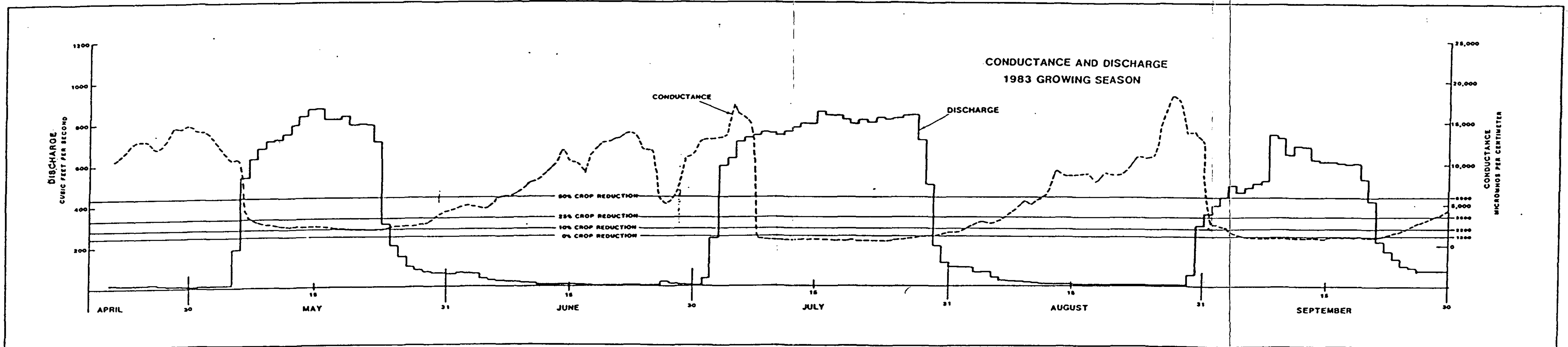


Figure 4-8 Relationship between conductance and discharge in Pecos River near Artesia (unpublished data from USGS).

and the Pecos River loses water. During low flow periods the gradient is reversed. Figure 4-9 is a potentiometric surface map of the area near the evaporation ponds.

4.5 SURFACE WATER HYDROGEOLOGY AND FLOODING POTENTIAL

Artesia lies in the eastern plains of New Mexico on a broad, mature plateau developed on flat-lying bedrock. The city is at an average elevation of 3380 feet (msl) on an essentially featureless plain which slopes eastward at about 3 feet per mile (0.35 degrees). Surface drainage is typically controlled by small, ephemeral creeks and arroyos which flow eastward into the Pecos River. These small drainages are subparallel and spaced at about 0.75 to 1.5 miles.

The major drainage in the immediate Artesia area is Eagle Creek which runs from west to east through the city, northeast through the Navajo Refinery and then eastward to the Pecos (Figure 2-1). Eagle Creek's channel has been rectified (artificially formed and straightened) from west of Artesia to the Pecos. Discussions with the City of Artesia engineer (Mr. John Brown) indicate that there is no historical record of Eagle Creek overflowing its banks. However, such an overflow could occur in a 100 year event (5.0 inches of precipitation). To deal with this problem, the city is continuing its efforts at rectifying Eagle Creek and plans to construct a check dam several miles west of Artesia within 2 years. These measures will effectively remove Artesia and the Refinery from the 100-year floodplain.

The evaporation ponds and parts of the conveyance ditch lie in the geologic floodplain of the Pecos River. In the past, large releases from upstream reservoirs coupled with high rainfall events have resulted in minor damage to the conveyance ditch. The ponds are located on alluvial material next to the Pecos. Pond perimeters are 16 to 18 feet above the river channel, and the largest pond is protected by a 5-foot high dike. Analysis of historic records of Pecos floods (Patterson, 1965; USGS unpublished data 1946-1983) shows that a maximum stage height of 17.4 feet was reached on September 30, 1932. Is is unlikely that this level will ever be equalled, owing to the construction of several flood-control dams (Alamogordo, Los Esteros) on the upper Pecos. No discharge event since 1941 has exceeded the 13.76 foot stage (25,200 cfs on October 8, 1954) and no discharge since 1960 has exceeded 7000 cfs. Modern "floods" in the Pecos are now controlled releases of water for irrigation, and these discharges are deliberately controlled to prevent any actual or potential flooding of lands and structures adjacent to the Pecos. Any release or rainfall event large enough to flood the evaporation ponds would effectively dilute the effluent to a level far below stream or ground water standards.

4.6 GROUND WATER QUALITY

Four separate hydrogeologic units are present at the Navajo facility:

- o the artesian aquifer (San Andres)
- o the shallow aquifer (upper Queen)
- o the Pecos River Valley alluvium, and
- o the perched water in the terrace regolith and surficial deposits.

The well-defined pressure regime in the confined aquifers (San Andres and the upper Queen) demonstrates that these units cannot be degraded by surficial sources (Section 4.4).
Therefore, water quality data for these units was not collected for this study. Published data on the water quality of these units are available (NMEID, 1980).

The water chemistry of the two surficial water-bearing units which have the potential of being affected by Navajo's operation is summarized in Appendix B. The water quality in the Pecos River Valley alluvial sand/silt aquifer is well defined near the evaporation ponds and is consistent with surface water quality data from the Pecos River (Figure 4-8). Comparison of ground water quality with water quality in the evaporation ponds reveals that, in terms of the major cations/anions and metals, the water quality in the lagoons is better than or equal to ground water quality (Appendix B). Both are unsuitable for use as irrigation, domestic or industrial purposes. Even though some monitor wells have an odor characteristic of hydrocarbons, in all wells sampled except for well #13 neither phenols, toluene nor benzene are present in concentrations above ground water standards.

Water quality in the perched terrace/regolith water-bearing unit is also well defined (Appendix B). The water quality in this unit is better than the Pecos Valley alluvium. It should be noted that the ground water in this perched water-bearing zone under the refinery is under some artesian pressure. Direct contamination of this ground water is therefore unlikely. The lithologic logs of the monitor wells (Appendix A) indicate that the soil in the aquitards above the unit is locally contaminated from surficial spills. Therefore, the ground water in some wells may in fact be unaffected by spills and other discharges. High hydrocarbon or TDS content in samples from these wells could be a result of artesian water in the well bore coming into contact with contaminated soil. Many wells have been installed to identify zones of hydrocarbon contamination and four oil recovery systems have been installed to recover product and therefore, mitigate the hydrocarbon contamination (Figure 4-7).

This shallow, perched-water unit appears to be of limited areal extent, and does not seem to be utilized by any wells off the plant site. It is not connected with any of the other aquifers, and it is very unlikely that any possible hydrocarbon contamination would affect any other ground water.

5.0 PROCESS DESCRIPTION AND WASTEWATER CHARACTERISTICS

5.1 OVERVIEW

A petroleum refinery is a complex combination of interdependent operations engaged in separating crude molecular constituents, molecular cracking, molecular rebuilding, and solvent finishing to produce petroleum-derived products. There are a number of distinct processes utilized by the industry for the refining crude petroleum and its fractionation products. An EPA survey of the petroleum refining industry, conducted during 1977, indentified over 150 separate processes being used and indentified many more process combinations that may be employed at any individual refinery.

Each process is itself a series of unit operations which cause chemical and/or physical changes in the feedstock or product. In the commercial synthesis of a single product from a single feedstock there are sections of the process associated with the preparation of the feedstock, the chemical reaction, the separation of reaction products, and the final purification of the desired product.

At the Navajo Refining Company Artesia, New Mexico facility the major refining processes are:

1) Crude Oil Fractionation (with vacuum fractionation)
2) Fluidized Catalytic cracking
3) Alkylation
4) Reforming
5) Desulferization

Associated with these processes are several auxiliary activities which do not directly result in conversion of crude oil to product nor result in complex chemical changes in the product but instead separate impurities from the feedstocks and products, or are required for other aspects of the operation and maintenance of refinery.

These auxiliary units are:

1. Boilers
2. Cooling towers
3. Storage tanks
4. Water purification facilities
5. Desalting units
6. Drying and sweetening units

Figure 5-1 shows the location of these process and auxiliary units at the refinery. The North Division of the refinery processes New Mexico intermediate crude whereas the South Division processes sour crude. The Artesia facility can refine a total of about 30,000 barrels of crude per day with the South Division producing about two-thirds of the total. Figure 5-2 is a process diagram which shows the interrelationship between the two divisions and the location of discharge points.

Each process or auxiliary unit operation has different water usages associated with it and the nature and quantity of waste water produced by the units varies according to the process involved. The final aqueous effluent of the Artesia Refinery is a blend of 19 process and auxiliary waste streams (Table 5-1) as well as some additional wastewater produced during general cleanup at the facility. The relative flow volumes from the different units are:

Cooling Towers	60%
Boiler Blowdown	20%
Desalter	8%
Process Units and Water Softener	12%

Based upon four wier measurements taken over the course of several days, the total effluent discharge is approximately 0.627 cfs or about 405,200 gallons per day.

A brief description of each process and its wastewater characteristics is given below.

5.2 MAIN PROCESS UNIT DESCRIPTIONS AND WASTEWATER CHARACTERISTICS

5.2.1. Crude Oil Fractionation

Fractionation serves as the basic refining process for the separation of crude petroleum into intermediate fractions of specific boiling-point ranges. Fractionation is a thermal distillation process which, at the south crude unit, yields gas, straight run gasoline, naptha, kerosene, diesel, atmospheric gas oil and reduced crude (Figure 5-2). Reduced crude is transferred to the associated vacuum unit where it is further fractionated into asphalt and vacuumed gas oil.

In the North Crude Unit, where New Mexico intermediate crude is refined, the product streams consist of gas, straight run gasoline, naptha, kerosene, diesel and topped crude. Wastewater produced from the crude units contains ammonia, sulfides, chlorides, oil, and phenols. The process description flow sheet (Figure 5-2) shows the location of all wastewater discharges for this and other units. Table 5-1 summarizes the type of effluent produced at each unit and shows the treatment units to which the streams are discharged. Four wastestreams originate in the crude units the bleedstream from the overhead accumulators #4, #5 #8 #11 and #13 and the effluent from the vacuum distillation unit (co-mingled with blowdown from the TCC cooling tower, #7).

TABLE 5-1
PROCESS UNITS AND WASTEWATER TREATMENT/DISPOSAL UNITS

LOCATION	PROCESS UNIT	WASTE STREAM SOURCE NUMBER	DISPOSAL/ TREATMENT SYSTEM
South Division	Cooling Tower	1	To south division API Separator
South Division	Boilers	2	To fire control system water storage ponds overflow directly into colveyance ditch
South Division	Crude Unit Desalter (D-130)	3	To south division API separator
South Division	Crude Unit Overhead Accumulator (D-140)	4	To south division API separator
South Division	Crude Unit Stabilizer (D-202)	5	To south division API separator
South Division	Alkylation Unit Regenerator	6	To API separator
South Division TCC Unit	Cooling Tower and Vacuum Unit	7	To south division API separator
South Division	Crude Unit Straight Run Gasoline stabilizer (W-58)	8	To API separator
North Division	Crude Unit Desalters (D-1, D-2)	9	To north division oil/water separator
North Division	Cooling Tower	10	To north division oil/water separator

Table 5-1 Continued

North Division	Crude Unit Overhead Accumulator (D-5)	11	To oil/water separator
North Division	Low Pressure Boiler	12	To North division oil/water separator
North Division	Crude Unit Overhead Accumulator (D-4)	13	North division oil/water separator
North Division	Desulfurizers (D-15)	14	North division oil/water separator
North Division	Fluidized Cat. Cracker Unit Cooling Tower	15	North division oil/water separator
North Division	Sour Water Stripper Bottom	16	To desalters, excess to North division oil/water separator
North Division	High pressure Boilers	17	To North division oil/water separator
North Division	FCC overhead accumulator Unit (DA-301)	18	To north division oil/water separator

Un-numbered waste streams on Figure 5-2 have not been analyzed

Like all wastestreams that have contacted crude or product (contact wastewater) and contain oil, these streams are treated in the oil/water separators prior to release into the conveyance ditch and the evaporation ponds. A chemical characterization of wastestreams #4, #5, #8, #11 and #13 is shown in Table 5-2.

5.2.2. Catalytic cracking

Fluidized catalytic cracking process is employed at Navajo. Catalytic cracking involves at least four types of reactions:

1) Thermal decomposition
2) Primary catalytic reactions at the catalyst surface
3) Secondary catalytic reactions between the primary products
4) Removal of products which may be polymerized from further reactions by adsorption onto the surface of a fluidized bed of catalyst as coke.

The catalysts are in the form of powder for the fluidized unit. The catalyst is usually heated and lifted into the reactor area by the incoming oil feed which, in turn, is vaporized upon contact. Vapors from the reactors pass upward through a cyclone separator which removes most of the entrained catalyst. These vapors then enter the fractionator, where the desired products are removed and heavier fractions recycled to the reactor.

The major wastewater constituents resulting from catalytic cracking operations are oil, sulfides, phenols, cyanides, and ammonia. These produce an alkaline wastewater with high BOD and COD concentrations. Sulfide and phenol concentrations in the wastewater can be significant. The wastestreams produced by the FCC unit are #19 and #15. Both #8 and #19 are also contact wastewater but are sent directly to the oil/water separators as shown in Table 5-1. A characterization of the effluent from the

TABLE 5-2
CHEMICAL ANALYSES OF SELECTED WASTE
STREAMS AT NAVAJO REFINERY (AFTER BRANVOLD, 1984)
(VALUES IN MG/L EXCEPT WHERE NOTED)

WQCC 3-103 STANDARDS	CRUDE UNIT PROCESS (#4, #11, #13)	CAT. CRACKER PROCESS BEFORE SOUR WATER STRIPPER	SOUR WATER STRIPPER EFFLUENT (#17)	ALKY. NEUTRALIZING SEWER (#6)	ND & SD DESALTERS (#3, #9)
As					
Ba					
Cd					
Cr	<0.1	<0.1	<0.1	7.8	
CN	<0.1	<0.1	<0.1	<0.1	<1.0
F	1.3	0.5	0.4	10.8	
Pb					
Hg					
NO_3					
Se					
Ag					
U					
Cl					
Cu					
Fe	<0.1	3.9	17.0	7.8	
Mn					
SO^4					
TDS	805	2160	560	2872	2524
Zn	<0.1	<0.1	0.12	18.8	
pH	6.3	9.0	9.5	3.6	
Al					
B					
Co					
Mo					
Ni					
Phenols	9.9	710	250	0.26	
TSS					
Cond.					
COD	1202	8379	1702	8870	600
NH_4	78	2320	256	<1	5.0
S	64	180	7.7	1.4	<1.0

Table 5-2 (continued)

BOILERS

WQCC 3-103 PARAMETERS	S.D. BOILER BLOWDOWN (#2)	N.D. HIGH PRESSURE BOILER (#18)	N.D. LOW PRESSURE BOILER (#12)
As	.004	.005	.003
Ba	<.1	<.1	<.1
Cd	<.01	<.01	<.01
Cr	<.05	<.05	<.05
CN			
F	3.1	2.2	1.5
Pb	.18	.14	.05
Hg			
NO_3	.2	.1	.05
Se			
Ag	<.05	<.05	<.05
U	<.05	<.05	<.05
Cl	127	73	44
Cu	<.03	<.03	<.03
Fe	1.9	0.65	0.25
Mn	.07	<.03	<.03
SO	1549	1242	693
TDS	4220	2873	1807
Zn	.06	<.01	<.01
pH	11.6	11.6	11.2
Al	<1.0	<1.0	<1.0
B			
Co	<.01	.02	.01
Mo	<.5	<.5	<.5
Ni	<.05	<.05	<.05
Phenols			
TSS	20	0	0
Cond.	6000	5000	2800
COD	116	0	0
NH_4			
S			

Table 5-2 (continued)

COOLING TOWERS

WQCC 3-103 STANDARDS	N.D. COOLING TOWER BLOWDOWN (#10)	S.D. ALKY COOLING TOWER BLOWDOWN (#1)	S.D. TCC COOLING TOWER BLOWDOWN	N.D. FCC COOLING TOWER BLOWDOWN (#16)
As	.004	<.001	.011	.001
Ba	<.1	<.1	<.1	<.1
Cd	<.01	<.01	<.01	<.01
Cr	.06	1.05	<.05	0.22
CN				
F	1.6	4.4	2.2	1.6
Pb	.05	.05	<.05	.05
Hg				
NO_3	.5	.75	.2	.3
Se				
Ag	<.05	<.05	<.05	<.05
U	<.05	<.05	<.05	<.05
Cl	48	53	44	47
Cu	<.03	<.03	<.03	<.03
Fe	.05	.5	<.05	<.05
Mn	<.03	.07	<.03	<.03
SO	1077	1461	1236	1067
TDS*	1906	2732	1694	1973
Zn	.48	28	<.01	.17
pH	7.6	6.9	7.7	8.0
Al	<1.0	<1.0	1.0	<1.0
B				
Co	<.01	.01	.02	.01
Mo	<.5	<.5	<.5	<.5
Ni	<.05	<.07	<.05	<.05
Phenols				
TSS	13	0	67	0
Cond.	0	0	108	1800
COD	1850			15
NH_4	0			

catalytic cracking process before and after sour water stripping is displayed in Table 5-2.

5.2.3. Alkylation

Alkylation is the reaction of an isoparaffin (usually isobutane) and an olefin (butylenes) in the presence of hydroflouoric acid as a catalyst at carefully controlled temperatures and pressures to produce a high octane alkylate for use as a gasoline blending component. The reaction products are separated in a catalyst recovery unit, from which the catalyst is recycled. The hydrocarbon stream is passed through a caustic and water wash after going to the fractionation section.

The wastewater from the alkylation unit is an acidic solution containing some suspended solids, oil, dissolved solids, fluoride and phenols. The waste stream (#6) is discharged to the neutralizing sewer and is treated to raise the pH prior to discharge to the API oil/water separator (see Table 5-1). An analysis of this coming wastestream is shown in Table 5-2.

5.2.4. Reforming

Reforming converts low octane naphtha, naphthene-rich stocks to high-octane gasoline blending stock, aromatics for petrochemical use, and isobutane. At Navajo the reformers do not produce a waste stream. Feed stocks are usually hydrotreated for the removal of sulfur and nitrogen compounds prior to charging to the reformer (see Section 5.3.6), since the extremely expensive platinum catalysts used in the unit are readily contaminated and ruined by the sulfur and nitrogen compounds. The predominant reaction during reforming is the dehydrogenation of naphthenes.

Important secondary reactions are the isomerization, cyclization and cracking of paraffins. All reactions result in high octane products.

5.2.5 Desulfurizers

Desulfurizing is primarily used to remove sulfur compounds, and other impurities from gasoline, kerosene, jet fuels and diesel fuel. The wastewater typically consists of sulfides or phenolic compounds. This waste stream (#14) is routed to oil water separator.

5.3 AUXILIARY PROCESS UNIT DESCRIPTIONS AND WASTEWATER CHARACTERISTICS

5.3.1 Boilers

Steam is consumed throughout the refining process and is generated in boilers at the North and South Divisions. To assure proper operation of the boilers, a certain amount of boiler water must be discharged (blowdown) and treated water added as make-up. Boiler blowdown is used as a water source for the fire protection system (Table 5-1) prior to direct discharge into the conveyance ditch. Analyses of the boiler blowdown wastestreams (#2, #17 and #12) are shown in Table 5-2. A characterization of the fire water pond is also included in Appendix B.

5.3.2 Cooling Towers

Water used for cooling process streams throughout the facility is cooled by cooling towers located in both the North and South Divisions and comprises most of the water usage at the facility. A significant amount of water is lost by evaporation in the cooling towers resulting in an increased concentration of dissolved solids in the cooling water over time. To prevent scaling, corrosion and biological growth in the towers, inhibitors such as chromate are added to the cooling water. Blowdown from cooling towers pass through the oil water separator to permit contact of chromate with the oil in the separator. This precipitates much of the metal due to reduction of the metal. Analyses of cooling tower blowdown (#1, #10 and #15) is displayed in Table 5-2.

5.3.3 Water Purification System

Pure water must be supplied to several of the boiler units as well as some process systems. Backwash from the purification system contains dissolved solids removed from the water supply system. The water purification system is basically a water softener and produces a periodic waste stream enriched in dissolved solids. The waste is never in contact with product and is discharged directly into the conveyance ditch in the South Division and to the Oil Water separator in the North Division.

5.3.4 Desalters

All produced crude contains some formation (connate) water and suspended solids. Because SE New Mexico crude is generally found in marine formations, this water is highly saline.

Desalters remove the saline fluid and suspended solids from the crude by passing crude (with some added water) through an electrostatic field which acts to agglomerate the dispersed brine droplets.

Wastewater can contain high dissolved solids, phenols and (depending upon crude type) ammonia and sulfides. This contact waste water is discharged to the oil-water separator. This waste stream is a significant contributer to the total effluent volume. A characterization of desalter effluent (streams #3 and #9) is shown in Table 5-2.

5.3.5 Washdown and Stormwater

A certain amount of wash water is intermittently utilized for general clean-up of the facility. This activity occurs within the concrete lined process areas. In areas where the clean up may result in oil-contaminated water, the areas drain to the oil water separator sewer. At the heat-exchanger bundle cleaning area the concrete pad drains directly into a sump which is constructed similar to an oil water separator thence into the conveyance ditch and thence to the evaporation ponds.

5.3.6 Storage Tanks

Storage of crude and product typically permits some separation of any water or suspended solids entrained in the fluid. These wastes, removed from the tank bottoms, contain emulsified oil, phenols, iron, sulfide and other consituents which depend upon the nature of the material stored in a particular tank. This liquid is removed to the oil water separators by vacuum trucks. The volume of effluent from this unnumbered source is also small.

5.3.7 Produced Water from Oil Recovery System

The oil recovery system pumps water from below the oil-water interface in order to create a gradient toward the skimmer pump in the trench. This water is discharged directly into the conveyance ditch.

6.0 PRESENT WASTE MANAGEMENT SYSTEM

The Navajo Artesia Refinery generates, treats and disposes of liquid and solid wastes. RCRA solid wastes, which include oil-water separator sludges, heat exchanger bundle cleaning sludges, slop oil emulsion solids and, when produced, leaded tank bottoms are disposed of at the RCRA landfarms on the refinery site pursuant to U.S. EPA regulatory provisions. These waste treatment facilities are fully addressed in EPA permitting documents and are not discussed further in this discharge plan.

The wastewater management system presently employed by Navajo is composed of four units: the evaporation ponds, the conveyance ditch, and the two oil-water separators. A general description of each unit is provided below.

6.1 OIL/WATER SEPARATORS

All wastewater delivered to the oil-water separators flow by gravity from the discharge points through subsurface pipelines. At the separators the flow velocity is reduced and the density difference between the water and entrained oil permits separation of the two phases. The oil is then skimmed from the water and pumped back to the processing units. Chromate and other metals which are discharged into the separator are removed from solution by the reducing effect of the hydrocarbons. The effluent is discharged to the conveyance ditch. The sludges are removed to the RCRA landfarm.

Periodically, blow sand and suspended solids in the effluent will enter the separator and oil droplets may adhere to the solid. This phenomenon results in a sand/oil particle which may have the same density as water. These oily particles can flow through the unit and into the conveyance ditch. Upsets in the plant can also result in a short-term oily discharge from the separators. Much of the oil and grease discharged into the ditch will settle into the soft, bottom sediments. Over time this oil, grease and sediment has formed a very fine-grained asphaltic "liner" for the ditch.

6.2 Conveyance Ditch

The conveyance ditch originates at the oil-water separators and terminates at the evaporation ponds in Section 1,6 and 12 (T. 17 S., R. 26 E.) approximately three miles east of the refinery. As Figure 2-1 shows, the ditch is sub-parallel to Eagle Creek until it nears the Pecos River, where the ditch then turns south toward the evaporation ponds. The ditch is generally about 3-4 feet wide and less than 1 foot deep. Throughout its course, it is bermed to prevent any influx of stormwater or excess irrigation water.

In the refinery area several wastestreams discharge directly into the ditch. These streams (eg. boiler blowdown) are not contact wastewater and, therefore, need not be routed to the oil/ water separators.

6.3 Evaporation Ponds

Originally, three ponds were built to evaporate the wastewater generated at the refinery. At the present time, the berm between the lower ponds (2 and 3) has been removed resulting in a two-pond system. The ponds cover an area of approximately 85 acres square feet and are generally less than 3 feet deep. The ponds are bermed to prevent any storm water runoff from entering the impoundment.

All of the wastewater discharged by the refinery is disposed of in these ponds. The effluent in these ponds is a very good representation of the overall quality of the discharges from the facility. Upsets in the refinery and minor modifications of the operation could result in a variable quality of discharge. The ponds, however, have a long enough retention time to adequately homogenize the effluent. Analyses of the fluid in the ponds is shown in Appendix B.

REFERENCES CITED

1. Kelley, V.C., 1971 Geology of the Pecos Country, Southeastern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Memoir 24, Socorro, New Mexico, 77p. 7 maps.

2. New Mexico Environmental Improvement Division, 1980, Chemical Quality of New Mexico Community Water Supplies, 256 p.

3. Patterson, J.L., 1965, Magnitude and Frequency of Floods in the United States, part 8: United States Geological Survey Water Supply Paper 1682, Washington, D.C., 506 p., 1 map.

4. United States Soil Conversation Service, 1971, Soil Survey of Eddy Area, New Mexico: United States Department of Agriculture, Washington, D.C. 82 p., 152 maps.

5. Welder, E.G., 1983, Geohydrologic Framework of the Roswell Ground-Water Basin, Chaves and Eddy Countries, New Mexico: New Mexico State Engineer's Technical Report 42, Santa Fe, New Mexico, 28 p, 28 maps.

APPENDICES FOR
NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO

December 4, 1984

Prepared for:

Dave Griffin
Navajo Refining Company
P.O. Drawer 159
Artesia, New Mexico 88210

Prepared by:

Gecscience Consultants, Ltd.
500 Copper Avenue NW
Suite 220
Albuquerque, New Mexico 87102

APPENDIX A
WELL LOGS

LITHOLOGIC AND COMPLETION LOGS OF
NAVAJO'S MONITORING WELLS

APPENDICES FOR NAVAJO REFINING COMPANY ARTESIA, NEW MEXICO

December 4, 1984

Prepared for:

Dave Griffin
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APPENDIX A
WELL LOGS

LITHOLOGIC AND COMPLETION LOGS OF
NAVAJO'S MONITORING WELLS

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

#13

(A) Owner of well Navajo Refining Co. Owner's Well No. ____
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143-X-13 and is located in the:

a. SE ¼ SE ¼ NW ¼ ____ ¼ of Section 12 Township 17S Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-23-77 Completed 6-23-77 Type tools cable Size of hole 890 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 21 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
890	4	P/E	2	21	23	P/E	3	20

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ____ FWL ____ FSL ____

File No. RA-6143-X-13 Use OBSERV. & EXPL. Location No. 17.26.12.42233

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	21	21	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'77 AUG 31 AM 8 38

STATE ENGINEER OFFICE
ROSWELL, N.M.

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

Driller

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

Revised June 1972

FIELD ENGR. LOG

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 16
Street or Post Office Address Box 159
City and State Artesia, New Mexico 88210

Well was drilled under Permit No. RA-6775-E and is located in the:

a. SW ¼ SE ¼ NE ¼ NW ¼ of Section 12 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Clyde Tidwell License No. WD-406

Address Box 17, Route 1, Artesia, New Mexico 88210

Drilling Began 3/21/81 Completed 3/29/81 Type tools Cable Size of hole 8 in.

Elevation of land surface ______ at well is 3307 ft. Total depth of well 60 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
10	25	15	Red Sand	NA
28	35	7	Gray Sand	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8 5/8	28		0	60	60	Texas Pattern	NA	

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received April 6, 1981

Quad ______ FWL ______ FSL ______

File No. RA-6775-E Use Observation Location No. 17S.26E.12.1224

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	25	25	Fine red sand
25	28	3	Blue-gray clay
28	35	7	Fine gray sand
35	46	11	Coarse gravel
46	60	14	med to fine gravelly sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'81 APR 6 AM 8 03
STATE ENGINEER OFFICE
ROSWELL, N.M.

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

Clyde J. Tidwell
Driller

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

Revised June 1972

3

FIELD ENGR. LOG

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Navajo Refining Co. Owner's Well No.
Street or Post Office Address P.O. Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143-X-2 and is located in the:

a. NW ¼ NW ¼ NW ¼ ___ ¼ of Section 12 Township 17S Range 26E N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-16-77 Completed 6-16-77 Type tools cable Size of hole 890 in.

Elevation of land surface or ___ at well is ___ ft. Total depth of well 20 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
890	4	P/E	2	20	22	P/e	3	19

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

___
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ___ FWL ___ FSL ___

File No. RA-6143-X-2 Use OBS. & EXPL. Location No. 17.26.12.11113

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	20	20	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'77 AUG 31 AM 8 48
STATE ENGINEER OFFICE
ROSWELL N. M.

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

Tony Hall
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG
#3

Section 1. GENERAL INFORMATION

(A) Owner of well Navajo Refining Co. Owner's Well No. ______
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143 and is located in the:

a. SW ¼ NE ¼ NW ¼ ______ ¼ of Section 12 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-17-77 Completed 6-17-77 Type tools cable Size of hole 8⅝" in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 23 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8⅝"	4	P/E	2	23	25	P/E	3	22

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

File No. RA-6143 Use OBS. & EXPL. Location No. 17.26.12.12322l

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	23	23	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'77 AUG 31 AM 8 40

STATE ENGINEER OFFICE
ROSWELL, N. M.

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

Tony Hall
Driller

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

Revised June 1972

SANTA FE

STATE ENGINEER OFFICE
WELL RECORD

#5

Section 1. GENERAL INFORMATION

(A) Owner of well Navajo Refining Co. Owner's Well No. ______
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. M-6143-X-5 and is located in the:

a. NW ¼ SW ¼ SE ¼ ____ ¼ of Section 1 Township 17S Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-18-77 Completed 6-18-77 Type tools cable Size of hole 8SD in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 21 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
			N/A	

Depth
0-21 ft
21 feet
Sand

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8SD	4	P/E	2	21	23	P/E	3	20

Section 4. RECORD OF MUDDING AND CEMENTING

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

1978 JAN 16 AM 11 14
STATE ENGINEER OFFICE

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

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

Revised June 1972

SANTA FE

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

#7

(A) Owner of well Navajo Refining Co. Owner's Well No. ______
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143-X-7 and is located in the:

a. NE ¼ SE ¼ SE ¼ ______ ¼ of Section 1 Township 17S Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-20-77 Completed 6-20-77 Type tools cable Size of hole 8SD in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 22 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Depth
0-22ft
22 feet
Sand

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8SD	4	P/E	2	22	24	P/E	3	21

Section 4. RECORD OF MUDDING AND CEMENTING

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

1978 JAN 16 PM 1:14
STATE ENGINEER OFFICE
SANTA FE, N.M.

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

File No. RA-6143-X-7 Use OBS. & Expl. Location No. 17.26.1. [illegible]

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

#9

(A) Owner of well Navajo Refining Co. Owner's Well No.
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143-X-9 and is located in the:

a. SE ¼ NE ¼ NE ¼ ¼ of Section 1 12 Township 17S Range 26E N.M.P.M.

b. Tract No. of Map No. of the

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-21-77 Completed 6-21-77 Type tools cable Size of hole 890 in.

Elevation of land surface or at well is ft. Total depth of well 21 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
890	4	P/E	2	21	23	P/E	3	20

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad FWL FSL

File No. RA-6143-X-9 Use OBS. & EXPL. Location No. 17.26.12.24243

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	21	21	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'77 AUG 31

STATE ENGINEER OFFICE
ROSWELL, N. MEX.

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

Tom Hall
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

FIELD ENGR. LOG

WELL RECORD

Section 1. GENERAL INFORMATION

#12

(A) Owner of well Navajo Refining Co. Owner's Well No. ______
Street or Post Office Address Drawer 159
City and State Artesia, New Mexico

Well was drilled under Permit No. RA-6143-X-12 and is located in the:

a. SE ¼ SE ¼ NE ¼ ______ ¼ of Section 12 Township 17 Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, New Mexico

Drilling Began 6-22-77 Completed 6-22-77 Type tools cable Size of hole 8ØD in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 19 ft.

Completed well is ☐ shallow ☐ artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			N/A	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8ØD	4	P/E	2	19	21	P/E	3	18

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad ______ FWL ______ FSL ______

File No. RA-6143-X-12 Use OBS. & EXPL. Location No. 17.26.12. .41234

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	19	19	Sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

'77 AUG 31 AM 8 38
STATE ENGINEER OFFICE
ROSWELL N.M.

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

Tom Hall
Driller

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

Revised June 1972

FIELD ENGR. LOG

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 16

Street or Post Office Address Box 159

City and State Artesia, New Mexico 88210

Well was drilled under Permit No. RA-6775-E and is located in the:

a. SW ¼ SE ¼ NE ¼ NW ¼ of Section 12 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Clyde Tidwell License No. WD-406

Address Box 17, Route 1, Artesia, New Mexico 88210

Drilling Began 3/21/81 Completed 3/29/81 Type tools Cable Size of hole 8 in.

Elevation of land surface ~~or~~ ______ at well is 3307 ft. Total depth of well 60 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
10	25	15	Red Sand	NA
28	35	7	Gray Sand	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8 5/8	28		0	60	60	Texas Pattern	NA	

Section 4. RECORD OF MUDDING AND CEMENTING

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

MAR 06 1985

OIL CONSERVATION DIVISION SANTA FE

Section 5. PLUGGING RECORD

Plugging Contractor ______

Address ______

Plugging Method ______

Date Well Plugged ______

Plugging approved by:

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received April 6, 1981

Quad ______ FWL ______ FSL ______

File No. RA-6775-E Use Observation Location No. 17S.26E.12.1224

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	25	25	Fine red sand
25	28	3	Blue-gray clay
28	35	7	Fine gray sand
35	46	11	Coarse gravel
46	60	14	med to fine gravelly sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

RECEIVED
MAR 06 1985
OIL CONSERVATION DIVISION
SANTA FE

'81 APR 6 AM 8 03
STATE ENGINEER OFFICE
ROSWELL, N.M.

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

Clyde J. Tidwell
Driller

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

Revised June 1972

FIELD ENGR. LOG

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 17
Street or Post Office Address Box 159
City and State Artesia, New Mexico 88210

Well was drilled under Permit No. RA- 6776-E and is located in the:

a. SE ¼ NE ¼ NE ¼ NW ¼ of Section 12 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Clyde Tidwell License No. WD-406

Address Box 17, Route 1, Artesia, New Mexico 88210

Drilling Began 3/29/81 *Completed* 3/29/81 Type tools Cable Size of hole 8 in.

Elevation of land surface or ______ at well is 3305 ft. Total depth of well 30 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
10	28	18	Red sand	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8 5/8"	28		0	30	30	Texas Pattern	NA	

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received April 6, 1981

Quad ______ FWL ______ FSL ______

File No. RA-6776-E Use Observation Location No. 17S.26E.12.1243

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	28	28	Fine red sand
28	30	2	Red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

'81 APR 6 AM 8 03
STATE ENGINEER OFFICE
ROSWELL, N.MEX.

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

Clyde J. Tidwell
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 18
Street or Post Office Address Box 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6969 and is located in the: Observation/Monitor well

a. NW ¼ SW ¼ NW ¼ ____ ¼ of Section 9 Township 17S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Hughes Drilling Company License No. WD 749

Address Box 199A, Route 1, Artesia, N M 88210

Drilling Began 6/8/82 Completed 6/8/82 Type tools Air rotary Size of hole 7- 7/8 in.

Elevation of land surface or casing at well is 3364 ft. Total depth of well 19 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
16	19	3	fine anhydritic sand and red shale	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				20		15	19

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	12			3	hand

Section 5. PLUGGING RECORD

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

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received June 22, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6969 Use Obs./Monitoring Location No. 17.26.9.13111

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2	2	Red soil
2	8	6	gyp (weathered anhy) with red shale
8	14	6	gyp white and anhydritic sand
14	19	5	Fine red shale and anhyritic sand - water @ 16'

Section 7. REMARKS AND ADDITIONAL INFORMATION

observation/monitoring well

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 19
Street or Post Office Address Box 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6970 and is located in the: Observation/Monitor

a. NE ¼ SE ¼ NE ¼ ___ ¼ of Section 8 Township 17S Range 26 E N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

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

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

(B) Drilling Contractor Hughes Drilling Company License No. WD 749

Address Route 1, Box 199A, Artesia, N M 88210

Drilling Began 6/9/82 Completed 6/9/82 Type tools Air Rotary Size of hole 7 7/8 in.

Elevation of land surface or casing at well is 3367 ft. Total depth of well 19 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
15	18	3	fine anhydritic sand and shale	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				20		15	19

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	12			3	hand

Section 5. PLUGGING RECORD

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

___
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received June 22, 1982

Quad ___ FWL ___ FSL ___

File No. RA-6970 Use Monitoring Location No. 17.26.8.24234

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3½	3½	gravel
	6	2½	brown soil
	9	3	gyp
	18	9	gray clay & gyp
	19	1	Red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

observation/monitor well

JUN 22 8 03 AM '82

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 20

Street or Post Office Address Box 159

City and State Artesia, New Mexico 88210

Well was drilled under Permit No. RA 6972 and is located in the: observation/monitor

a. NW ¼ SW ¼ NW ¼ ______ ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Hughes Drilling Company License No. WD 749

Address Route 1, Box 199A, Artesia, N M 88210

Drilling Began 6/9/82 Completed 6/9/82 Type tools Air rotory Size of hole 7 7/8 in.

Elevation of land surface or casing at well is 3366 ft. Total depth of well 20 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 11 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
15	18	3	fine red & gray anhydritic sand	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	PVC				20		16	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	12			3	hand

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received June 22, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6972 Use Monitoring Location No. 17.26.9.13313

Section 6. LOG OF HOLE

Depth in Feet From	To	Thickness in Feet	Color and Type of Material Encountered
0	3	3	soil
	5	2	tan gyp - oil soaked
	10	5	gray anhydritic sand and shale
	15	5	50/50 gray & red anhydritic sand
	20	5	fine red shaley anhydritic sand

Section 7. REMARKS AND ADDITIONAL INFORMATION

observation/monitor well

JUN 22 8 03 AM '02

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 21
Street or Post Office Address Box 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6971 and is located in the: observation/monitor

a. NE ¼ NW ¼ ~~SE~~ SW ¼ ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor Hughes Drilling Company License No. WD 749

Address Route 1, Box 199A, Artesia, N M 88210

Drilling Began 6/11/82 Completed 6/11/82 Type tools Air rotary Size of hole 7 7/8 in.

Elevation of land surface or casing at well is 3362 ft. Total depth of well 33 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 7 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
16	20	4	fine gray anhydritic sand & shale	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				33		29	33

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	12			3	hand
12	33				gravel pack

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received June 22, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6971 Use Monitoring Location No. 17.26.9.31222

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	oil soaked sand
	10	5	fine anhydritic sand & clay
	15	5	fine anhydritic sand & clay
	20	5	fine gray anhy sd, clay, & gravel
	25	5	coarse gravel and gray clay cement
	30	5	gyp & red clay or shale
	33	3	very shaley gyp.

Section 7. *REMARKS AND ADDITIONAL INFORMATION*

JUN 22 8 09 AM '92

observation/monitor well

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

Dale Hughes

Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 22
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 and is located in the:

a. NE ¼ NE ¼ NW ¼ SW ¼ of Section 9 Township 17S Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, NM 88210

Drilling Began June 14, '82 Completed June 14, '82 Type tools Air Rotary Size of hole 7 7/8 in.

Elevation of land surface or ______ at well is 3359 ft. Total depth of well 19 ft.

Completed well is ☒ shallow ☐ artesian. Monitor Depth to water upon completion of well 5 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
16	18	2	gyp sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6					20		16	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	4	8		3	hand

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received **August 19, 1982**

Quad ______ FWL ______ FSL ______

File No. RA-6975 Use Observation Location No. 17.26.9.31222

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	4	4	fill
	5	1	oil soaked sand
	10	5	gyp and clay
	16	6	gyp and clay
	18	2	anhydritic sand, gravel
	19	1	gyp and clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

AUG 15 ... 23 AM '02

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

Dale Hughes
Driller

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

Revised June 1972

FIELD ENGR. LOG ✓

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 23
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X and is located in the:

a. NE ¼ NW ¼ NW ¼ SW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M 88210

Drilling Began 6/28/82 Completed 6/28/82 Type tools Air Rotary Size of hole 7 7/8 in.

Elevation of land surface or ______ at well is 3363 ft. Total depth of well 20 ft.

Completed well is [x] shallow [ ] artesian. Monitor Depth to water upon completion of well 9 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
15	17	2	Anhyritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	PVC				20		15	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	7	8		3	Hand

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6975 x Use Observation Location No. 17.26.9.31122

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	gyp with anhydrite crystals
	10	5	" " " "
	12	2	gyp and granular anhydrite
	15	3	anhydritic sand and clay
	17	2	" " " "
	20	3	anhy sand with limestone gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

'92 MAR 23 AM 10 31

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 24
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 2 and is located in the:

a. E ¼ SW ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199A, Artesia, N M 88210

Drilling Began 7/5/82 Completed 7/5/82 Type tools Air rotary Size of hole 8 in.

Elevation of land surface or ____ at well is 3362 ft. Total depth of well 19 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 8 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
16	18	2	Anhy sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				20		15	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	7	8		3	hand

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6975 X 2 Use Observation Location No. 17.26.9.13322

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	gyp & gran. anhydrite
	10	5	" " " "
	16	6	gyp & clay
	18	2	anhydritic sand and gravel
	19	1	gyp and gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

AUG 13 02 23 AM '02

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG ✓

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANH Owner's Well No. 25
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 3 and is located in the:

a. C ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A , Artesia, N M 88210

Drilling Began 7/13/82 Completed 7/13/ 82 Type tools Air rotary Size of hole 8 in.

Elevation of land surface or ____ at well is 3364 ft. Total depth of well 20 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 8 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
15	17	2	anhydritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				20		16	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	8	8		4	hand

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6975 X 3 Use Observation Location No. 17.26.8.24241

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	5	5	oil soaked soil
	12	7	gyp
	15	3	gyp & clay
	17	2	anhydritic sand
	20	3	red gyp clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes

Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG ✓

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 26
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 4 and is located in the:

a. SE ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M 88210

Drilling Began 7/15/82 Completed 7/15/82 Type tools Air Rotary Size of hole 8 in.

Elevation of land surface or ____ at well is 3364 ft. Total depth of well 20 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 8 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
16	18	2	anhydritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	PVC				20		16	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	9	8		5	hand

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6975 X 4 Use Observation Location No. 17.26.8.24243

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	6	6	oil soaked gyp
	10	4	gyp
	12	2	gyp & clay
	16	4	gyp & clay
	18	2	anhydritic sand
	20	2	gyp & gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

FIELD ENGR. LOG

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 27
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 5 and is located in the:

a. SE ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M 88210

Drilling Began 7/15/82 Completed 7/15/82 Type tools Air Rotary Size of hole 8 in.

Elevation of land surface or ______ at well is 3363 ft. Total depth of well 20 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 9 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
17	19	2	anhydritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				20		16	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	8	8		4	hand

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6975 X 5 Use Observation Location No. 17.26.8.24244

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	8	8	oil soaked gyp
	13	5	gyp
	17	4	gyp & clay
	19	2	anhydritic sand
	20	1	anhydritic sand & gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG ✓

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 28
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 6 and is located in the:

a. NE ¼ NE ¼ SE ¼ SW ¼ of Section 9 Township 17 S Range ~~28~~ 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M. 88210

Drilling Began 7/7/82 Completed 7/8/82 Type tools Air Rotary Size of hole 8 in.

Elevation of land surface or ______ at well is 3361 ft. Total depth of well 30 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
10	12	2	anhydritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	PVC				30		25	30

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	10	8		4	hand

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6975 X 6 Use ______ Location No. 17.26.9.34223

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	gyp & red clay
	10	5	" " "
	12	2	anhydritic sand & gravel
	25	13	gyp & gravel
	30	5	gyp

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG ✓

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 29
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 7 and is located in the:

a. ~~NE~~ ¼ ~~NE~~ ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M 88210

Drilling Began 7/20/82 Completed 7/21/82 Type tools Air rotary Size of hole 8 in.

Elevation of land surface or ____ at well is 3363 ft. Total depth of well 21.5 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 11 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
20	21.5	1.5	Anhydritic sand	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6	PVC				22		19	22

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	8	8		6	hand

Section 5. PLUGGING RECORD

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

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6975 X 7 Use Observation Location No. 17.26.9.13422

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	miscellaneous fill
	10	5	oil stained gyp
	15	5	gyp
	20	5	gyp
	21.5	1.5	anhydritic sand & gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG ✓

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 30
Street or Post Office Address Drawer 159
City and State Artesia, N M 88210

Well was drilled under Permit No. RA 6975 X 8 and is located in the:

a. NE ¼ NE ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Route 1, Box 199 A, Artesia, N M 88210

Drilling Began 7/22/82 Completed 7/22/82 Type tools Air Rotary Size of hole 8 in.

Elevation of land surface or ______ at well is 3358 ft. Total depth of well 21.5 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 8 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
18	20	2	anhydritic sand & gravel	na

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6	PVC				22		17	22

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	4	8		2	hand

Section 5. PLUGGING RECORD

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

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received August 19, 1982

Quad ______ FWL ______ FSL ______

File No. RA-6975 X 8 Use Observation Location No. 17.26.9.13222

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	5	5	oil soaked gravel, sand & gyp (fill)
	10	5	gyp
	15	5	gyp
	18	3	gyp & gravel
	20	2	anhydritic sand & gravel
	21.5	1.5	gyp & gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

AUG 13 3 29 AM '02

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 31
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA-6975-X-9 and is located in the:

a. SW ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. 1, Box 199 A, Artesia, N M. 88210

Drilling Began 10/19/82 Completed 10/19/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ____ at well is 3365 ft. Total depth of well 22 ft.

Completed well is [x] shallow [ ] artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
14	16	2	dolomite gravel w gray-brown silty clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2		PVC			18		13	18

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	12	8		4 sx	hand placement

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ____ FWL ____ FSL ____

File No. RA-6975-X-9 Use Observation Location No. 17.26.8.2423

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2	2	brown topsoil with gravel & concrete
2	3	1	brown silty clay w white pebbles
3	7	4	brown ~~tan~~ silty clay dense
7	8½	1½	tan silty clay
8½	14	5½	gray silty clay with gyp & unweathered anhydrite
14	16	2	dolo gravel water bearing seams w gry-brn silty clay
16	20	4	brown sandy silty clay
20	22	2	red clay well sorted

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 32
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA-7098-X-6 and is located in the:

a. NE ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. 1, Box 199 A, Artesia, N M 88210

Drilling Began 10/20/82 Completed 10/20/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ______ at well is 3363 ft. Total depth of well 24 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
16	22	6	Anhydritic sand & pebbles with brownish red sandy silty clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2	PVC				22		17	22

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	16	8		5 sx	Rose Gravel truck

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ______ FWL ______ FSL ______

File No. RA-7098-X-6 Use Observation Location No. 17. 26. 8. 2422

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2½	2½	Dark brown topsoil
2½	4	1½	lt. brown silty clay with unweathered anhydrite
4	6	2	tan silty clay
6	6½	½	red silty clay
6½	10½	4	lt brown silty clay with pebble seam at bottom
10½	13	2½	tan silty clay
13	16	3	gray silty clay
16	22	6	anhydritic sand & pebbles with brn-red sdy, silty clay
22	24	2	red clay hard

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 33
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA 7098 and is located in the:

a. NE ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. Box 199 A, Artesia, N M 88210

Drilling Began 10/20/82 Completed 10/20/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ______ at well is 3363 ft. Total depth of well 19½ ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 10 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
14½	17	2½	Anhy. sand with white gray silty clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
2	PVC				18		13	18

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	12	8		4 sx	Rose Gravel truck

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ______ FWL ______ FSL ______

File No. RA-7098 Use Observation Location No. 17.26.8.2422

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	4	4	Brown topsoil
4	13	9	lt brown silty clay w anhy.
13	14½	1½	gray silty clay
14½	17	2½	anHyd. sand in white gray silty clay & red-tan clay
17	19½	2½	red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 34
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA-7098-X and is located in the:

a. SE ¼ NE ¼ SE ¼ NE ¼ of Section 8 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. Box 199A, Artesia, NM 88210

Drilling Began 10/20/82 Completed 10/20/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ______ at well is 3363 ft. Total depth of well 22 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 9 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
16	20	4	Anhyd. sand in gray silty clay & gyp	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2	PVC				21		16	21

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	15	8		5 sx	Rose Gravel Truck

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ______ FWL ______ FSL ______

File No. RA-7098-X Use Observation Location No. 17.26.8.2424

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	6	6	Brown topsoil & fill
6	10	4	Gray-brown silty clay with unweathered anhydrite
10	16	6	gyp in silty clay & unweathered anhydrite
16	20	4	anhydritic sand in gray silty clay & gyp
20	22	2	gray clay.

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. / tions, except Section 5, shall be answered as completely and accura' ; possible when any well is drilled, repaired or deepen. , When this form is used as a plugging record, only Section 1(a) and Sectio. .eed be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 35

Street or Post Office Address Drawer 159

City and State Artesia, N M 88210

Well was drilled under Permit No. RA 7098 X 2 and is located in the:

a. SW ¼ SE ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. 1, Box 199 A, Artesia, N M 88210

Drilling Began 10/20/82 Completed 10/20/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ____ at well is 3362 ft. Total depth of well 21½ ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 7 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
15	20	5	Dolo gravel in tight gray sdy silty Clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2	PVC				20		15	20

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	14	8		4½ sx	Rose Gravel Truck

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ____ FWL ____ FSL ____

File No. RA-7098-X-2 Use Observation Location No. 17.26.9.1323

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2	2	Brown-white topfill
2	5	3	brn-gry silty clay with gravel & gyp
5	10	5	lt. brn silty clay with gravel
10	11½	1½	lt. brn silty clay with gravel
11½	15	3½	white silty clay w anhydrite
15	20	5	dolomite seams in tight gray sand-silty clay
20	21½	1½	dry tight white silty clay with anhydrite

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes

Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD Envn. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 36
Street or Post Office Address Drawer 159
City and State ARTESIA, NM 88210

Well was drilled under Permit No. RA 7098 X 3 and is located in the:

a. NE ¼ SE ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. 1, Box 199 A, Artesia, N M 88210

Drilling Began 10/21/82 Completed 10/21/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ______ at well is 3360½ ft. Total depth of well 25 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 7 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
14	15½	1½	Anhyd. clayey and in tight gype clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
2	PVC				17		12	17

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	11	8		4 sx	Rose Gravel Truck

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ______ FWL ______ FSL ______

File No. RA-7098-X-3 Use Observation Location No. 17.26.9.1342

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	4½	4½	Brown soil & fill
4½	8	3½	lt brn silty clay with gravel
8	14	6	gray silty clay
14	15½	1½	anhydritic clayey sand in tight gyp clay
15½	19	3½	white clay with anhydritic nodules, gyp
19	25	5	red-gray clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 37
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA 7098 X 4 and is located in the:

a. NE ¼ SE ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. Box 199 A, Artesia, N M 88210

Drilling Began 10/21/82 Completed 10/21/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ____ at well is 3361 ft. Total depth of well 20½ ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 8 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
14	18	4	Anhydritic sand in lt. gray silty clay w gyp	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2	PVC				17		12	17

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	11	8		4 sx	Rose gravel truck

Section 5. PLUGGING RECORD

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

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ____ FWL ____ FSL ____

File No. RA-7098-X-4 Use Observation Location No. 17.26.9.1342

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2½	2½	Brown topsoil & fill
2½	5	2½	Dark brown silty clay
5	14	9	Lt. brn silty clay
14	18	4	Anhydritic sand in light gray silty clay with gyp
18	20½	2½	Tight gray clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

INSTRUCTIONS: This for[m s]hould be executed in triplicate, preferably typewritten, and submitted t[o the] appropriate district office of the State Engineer. Al[l secti]ons, except Section 5, shall be answered as completely and accurate[ly as] possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 [n]eed be completed.

Revised June 1972

FIELD ENGR. LOG.

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well NAVAJO REFINING COMPANY Owner's Well No. 38
Street or Post Office Address Drawer 159
City and State ARTESIA, N M 88210

Well was drilled under Permit No. RA 7098 X 5 and is located in the:

a. SE ¼ SE ¼ SW ¼ NW ¼ of Section 9 Township 17 S Range 26 E N.M.P.M.

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

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

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

(B) Drilling Contractor S. Dale Hughes License No. WD 749

Address Rt. 1, Box 199 A, Artesia, N M 88210

Drilling Began 10/21/82 Completed 10/21/82 Type tools Auger Size of hole 8 in.

Elevation of land surface or ______ at well is 3361 ft. Total depth of well 23½ ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 6 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
16	21	5	Anhydritic sand & dolo pebbles with gray silty clay	NA

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
2	PVC				21		16	21

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet		Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
From	To				
0	15	8		5 sx	Rose Gravel Truck

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received November 9, 1982

Quad ______ FWL ______ FSL ______

File No. RA-7098-X-5 Use Observation Location No. 17.26.9.1344

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	4	4	Brown topsoil
4	6½	2½	Brn silty clay
6½	10	3½	Lt. brn silty clay - soft
10	11	1	Very hard Anhydrite
11	16	5	gray soft silty clay
16	21	5	Anhydritic sand & dolomite pebbles with dense gray silty clay
21	23½	2½	Very tight gray clay marbled with anhydrite

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Dale Hughes
Driller

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

Wells 31-38 also logged by
Geraghty and Miller, Inc.

Geraghty & Miller, Inc.

31

Well #1 31 **Sample Log** Page 1 of ___

Project Navajo Refinery Location SW corner of Colony Landfarm

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8 inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10/19/82 1:30 pm Date and Time Drilling End 3:00 pm

Geraghty and Miller Representative J. Dauchy T. Bourette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		fill - brown topsoil w/ gravel & concrete	0 - 2
		brittle brown silty clay, poorly sorted, w/ white pebbles	2 - 3
		brittle brown silty clay, dense, no pebbles	3 - 7
		tan silty clay, plastic, moist	7 - 8½
9-11-16	Split Spoon 8½-10 organic smell	gray silty clay w/ gyp. & unweather anhydrite, poorly sorted	8½ - 14
6-6-8	Split Spoon 14-15½	dolomite gravel water bearing seams (2") interbed w/ gray brown silty clay, saturated,	14 - 16
4-4-5	Split Spoon 17½-19	brown brittle sandy silty clay w/ red & white coarse grains	16 - 20
	Shelby Tube 20-22	red clay, well sorted, unsaturated	20 - 22

Well #32 **Sample Log** Page 2 of

Project Navajo Refinery Location SE corner of Telephone Storage

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10/20/82 7:20am Date and Time Drilling End 9:00am

Geraghty and Miller Representative J. Dauchy T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Dark brown topsoil	0 - 2½
		light brown silty clay w/ unweather anhydrite, poorly sorted	2½ - 4
3-4-5	Split Spoon 5-6½	tan silty clay, brittle, poorly sorted	4 - 6
		red silty clay	6 - 6½
5-6-10	Split Spoon 10-11½	light brown silty clay, mottled, poorly sorted	6½ - 10½
	organic smell	Pebble seam wet, dolomite gravel, 2"	10½
		tan silty clay, same as above	10½ - 13
5-8-12	Split Spoon 15-16½ organic smell	gray silty clay, well sorted, less dense	13 - 16
9-16-17	Split Spoon 17½-19	anhydritic sand & pebble seams interbed w/ brownish red sandy silty clay	16 - 22
6-7-9	Split Spoon 20-21½		
7-8-9	Split Spoon 22½-24	red clay, well sorted, dry & hard	22½ - 24

Geraghty & Miller, Inc.

Well # 33 **Sample Log** Page 3 of

Project Navajo Refinery Location NE of Colony @ Entrance Gate

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10/20/82 10:00AM Date and Time Drilling End 11:30 pm

Geraghty and Miller Representative J. Dauchy T. Bouvete

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Brown topsoil	0 - 4
	Shelby Tube 10-11	light brown silty clay w/ unweathered anhydrite, poorly sorted	4 - 13
	organic smell	gray brittle silty clay w/ white & red coarse grains	13 - 14½
3-7-8	Split Spoon 15-16½	Anhydritic sand interbedded in white gray silty clay and red & tan silty clay	14½ - 17
5-5-7	Split Spoon 17-18½	red clay	17 - 19½

Well #3 4 **Sample Log** Page 4 of ____

Project Navajo Refinery Location East Fence of Colony

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10-20-82 2:10pm Date and Time Drilling End 3:30pm

Geraghty and Miller Representative J. Dauchy T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Brown Topsoil & Fill	0-6
	organic smell	Gray brown mottled silty clay w/ unweather anhydrite, poorly sorted.	6-10
7-12-16	Split Spoon 10 - 11½	very brittle gyp in silty clay w/ unweathered anhydrite	10-16
	Shelby Tube 15-17	water bearing anhydritic sand inter lain in gray silty clay & gyp.	16-20
		gray clay, well sorted	20-22

Geraghty & Miller, Inc.

Well #35 **Sample Log** Page 5 of

Project Navajo Refinery Location SW corner @ TEL weathering

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10-20-82 4:25pm Date and Time Drilling End 5:45pm

Geraghty and Miller Representative J. Dauchy T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Brown white topfill	0 - 2
		brown gray silty clay w/ gravel (1") & gypsum	2 - 5
		light brown silty clay w/ gravel (3/8") well mixed	5 - 10
3-4-6	Split Spoon 10-11½	light brown silty clay w/out gravel, moist	10 - 11½
		white silty clay w/ anhydrite, very wet not saturated	11½ - 15
7-16-37	Split Spoon 15-16½	water bearing dolomite gravel seams in tight gray sandy silty clay	15 - 20
5-5-10	Split Spoon 20-21½	dry tight white silty clay w/ anhydrite	20 - 21½

Well #36 **Sample Log** Page 6 of

Project Navajo Refinery Location North of TEL in NonHazardous Landfarm

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10/21/82 7:20 am Date and Time Drilling End 8:35 am

Geraghty and Miller Representative J. Dauchy T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Brown topsoil & fill	0 - 4½
	organic smell	light brown silty clay w/ gravel (3/8") poorly sorted	4½ - 8
	organic smell	gray silty clay w/ black, red, & white coarse grains	8 - 14
18-33-50	large Split Spoon 15-16½	water bearing. anhydritic clayey sand in tight gyp clay	14 - 15½
10-8-7	Split Spoon 17½-19	white gray clay w/ anhydritic nodules, gypsum	15½ - 19
		red gray clay	19 - 25

Well #37 **Sample Log** Page 7 of ____

Project Navajo Refinery Location NE Corner of TEL

Drilling Contractor D. Anderson Driller Richard Helper Eddie

Rig Type Hollow Stem Hole Diameter 8" inches Drilling Fluid N/A

Type of Sample Split Spoon & Shelby Date and Time Drilling Began 10/21/82 1:05 Date and Time Drilling End 2:35

Geraghty and Miller Representative J. Dauchy T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		brown topsoil - fill	0-2½
	organic smell	dark brown silty clay mottled	2½-5
		light brown silty clay white & black pebbles poorly sorted	5-14
13-62-25	large Split Spoon 14-15½	anhydritic sand in light gray silty clay w/ gyp.	14-18
12-13-16	Split Spoon 19-20½	tight gray clay well sorted	18-20½

Well #3B   Sample Log   Page 8 of ____

Project Navajo Refinery   Location East Fence of TEL

Drilling Contractor D. Anderson   Driller Richard   Helper Eddie

Rig Type Hollow Stem   Hole Diameter 8" inches   Drilling Fluid N/A

Type of Sample Split Spoon & Shelby   Date and Time Drilling Began 10-21-82   Date and Time Drilling End ____

Geraghty and Miller Representative J. Dauchy   T. Bouvette

Blows per 6 inches	% Recovery	Sample Description	Depth Feet to Feet
		Brown topsoil	0-4
	organic smell	poorly sorted brown silty clay marbled w/ gray soft silty clay	4-6½
	organic smell	light brown silty clay soft, poorly sorted	6½-10
	Shelby Tube 10-12	very hard anhydrite (cement/crystals) w/ gray silty clay	10-11
9-17-19	Split Spoon 15-16½	gray soft silty clay, reddish tint, poorly sorted	11-16
4-8-9	Split Spoon 20-21½	anhydritic large grain sand & dolomite pebbles water bearing zones (1-2") interbed w/ dense gray silty clay	16-21
8-13-13	Split Spoon 22-23½	very tight gray clay marbled w/ anhydrite poorly sorted	21-23½

SAMPLE LOG

Well # 39 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6-13-84 Fasio & Chaney

331.7

Depth	Sample description
0-6	Lt Red clay soil
$10\frac{3}{4}$	gyp, anhy pebbles, clay
14	gry gyp. odor gas
$17\frac{1}{4}$	gry gyp, anhy - oil odor and stain
$18\frac{1}{2}$	anhy, gyp, clay
20	Red & gry shale, anhy & anhy xls, Red shale water
$21\frac{1}{2}$	Red clay, & anhy mixed with pebbles - water
$24\frac{3}{4}$	mixed red & white anhy & clay - some pebbles
26	fine red & wht anhy with clay - dry.

SAMPLE LOG

Well # 40 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6-14-84 Fasio & Chaney

Depth Sample description 336636

Depth	Sample description
0-4	soil
8½	gyp, anhy, gry shale dry
13	gyp, anhy, gry shale water
16½	anhy, shale, gyp - Bleeding oil
18½	Lt gry fine anhy - no oil
19¼	Lt gry, tan, granular anhy - oil
20¾	gyp - water
23¾	gyp, anhy - water
25¼	Tan, fine, xln anhy
28¼	Tan fxln anhy - sand - gravel at 25.55'
31½	Red sandy silt

SAMPLE LOG

Well # 41 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6-15-84 Fasio & Chaney

Depth Sample description

33

0-15	Soil - wet at 13.5 feet
16½	wht & Tan anhy & gyp - water
21	wht gyp with anhy pieces (gravelly)
25½	wht & gry gyp & anhy - dense
27½	gry sandy clay tight
29	Red & gry sandy clay
31	Red sandy shale (Clay)

SAMPLE LOG

Well # 42 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6-18-84 Fasio & Chaney
6-19-84 rain

Depth Sample description

0-10	Soil damp at 9'
14½	wht gyp, anhy & clay - tight
19½	wht gyp, anhy pebbles, clay water
22½	gyp + gry, red sandy silt
24	vy fine gry shaley silt with pebbles
29^{8}	gry shaley, sandy, silt
29	Red shaley, sandy, silt

SAMPLE LOG

Well # 43 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 7-17-84 Chaney - Stroud

7:15 am - 12:10 pm

Depth Sample description

0-4½	Soil
6	mixed soil (Red) & gyp. damp-
7^{5}	mixed Red shale + gyp - vy red shale at bottom
9	.67 mixed soil + gyp. - .88 gyp w HCR. Pebbles - anhy odor gas
10^{5}	gyp with anhy pebbles HCR- odor - no bldg oil
12	.75 gyp w/ anhy pebbles HCR- d/1st .75 wht gyp
13^{5}	1^{0} gyp w pebbles - gas stn + odor - 0^{5} gyp - slightly wet
15	0^{3} gyp + gravel - oil & wtr 1^{2} gyp, gravel - wet - free wtr - sli
16^{5}	0^{25} gyp + gravel - wtr - 1^{25} gry gyp - tight - wet
18	0^{75} loose gyp + gravel wtr - 1^{0} gyp w + anhy dolo pcs - 0^{25} Red silt sand
19^{5}	0^{6} Rd silty sandy + pebbles - 0^{9} Red fine silty sandy
22^{5}	Drl Rd silty sand - TD.

SAMPLE LOG

Well # 4

Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 7-17-84 Chaney - Stroud

2pm 5:25pm

Depth Sample description

330

0-16.5	Red silty-sandy soil
17	wht gyp - water
18.5	wht-gyp - dense-dry
20	0' wht gyp dns - 1± Red silty sandy clay
22.5	Red Clay - T.D.

SAMPLE LOG

Well #45 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 8/22/84 Stroud - Ledesma

By Effluent ditch at NW Corner farm 11' So. ℄ ditch

Depth	Sample description	
0 - 4.5	Red soil dry	
5	gyp - dry	~~57 blows~~
6.5	6.3 wht gyp. dry - 6.5 gry shale dry	57 blows
8	gry sdy shale w very lge anhy pcs - dry	
9.5	8.8 gry shale & gyp. 9.3 anhy gravel - 9.5 gry shale + anhy dry	
10	} 2' core sli damp to - dry	
11.5	10.8 - gry shale w anhy pcs - 11.3 anhy gravel - 11.5 gry shl Tr Red shale 11.5 - 12.3	49 blows
13	gry shale w gyp - anhy pcs - damp. wtr 3½' wtr on drl stem 6½'	40 blows
14.5	gravel at top; 14' and at 14.5 - gry shl w gravel streaks	27 blows
16	14.7 - 15 - gry shl + gravel - 15 - 16 - dark gry shale - wtr	
	TD	
	16' casing	
	gravel 16 - 10.5	
	Pellets 10.5 - 8.5	
	cmnt 8.5 - 0	

SAMPLE LOG

Well # 46   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger   8" diameter   Split spoon core barrel 18"

Date 8/22/84   Stroud - Ledesma

11:55 a

Depth   Sample description Center north side
Navajo - Collier Farm
3354

Depth	Sample description
0-6.5	Dark red soil
8	Lite Red soil & gyp dry
11	gry clay w gyp damp
12.5	Gry clay, gyp, anhy pc. - tight - dry
14	gry clay - gyp . anhy gravel - wtr
15.5	14-15.3 - Gry sdy-shale 15.3-.5 Red shale
17	Fine Red shale.
	TD
	Csg - 17'
	gravel + Perfs 17-12
	Pellets 12-10
	Cmnt 10-0

SAMPLE LOG

Well # ~~48~~ 47 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 8/22/84 Stroud - Ledesma

3:05

Depth Sample description SE Corner Navajo - Collier Farm

0 - 5	dark Red soil damp
10	lite Red soil damp
11.5	Red shale
13	Orange Red shale damp
14	" " "
	TD
	Casing 14'
	gravel & Perfs - 14-9
	Pellets 9-8
	Cmnt 8-0

SAMPLE LOG

Well # AA   Navajo Refining Company - Monitor wells

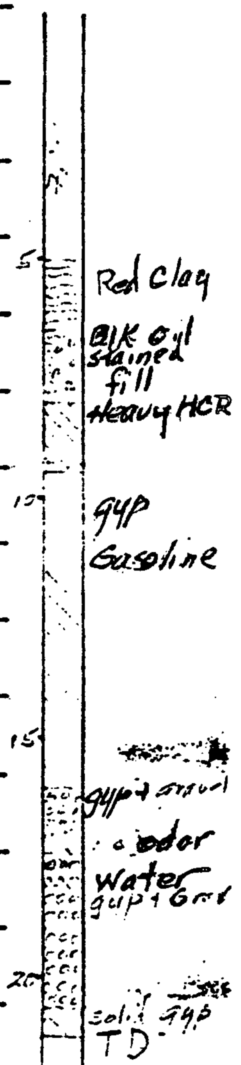
Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger   8" diameter   Split spoon core barrel 18"

Date 6/8/83   11:15 am

Depth   Sample description

0 - 5	Fill - clay & gravel
5 - 6½	Red clay - fill?
6½ - 8	Blk oil stained soil or fill Rec. 1' lost ½'
8 - 9½	Heavy HCR (hydrocarbon residue) in gypsum - oil odor Rec. 1' lst ½'
9½ - 10	Drill gyp
10 - 11½	1.1' gyp oil odor .4' gyp & red clay oil odor
11½ - 13	.5' porous gyp heavy gasoline odor. 1' gyp with gasoline odor
13 - 14½	.5' porous gyp gasoline dripping. 1' gyp
14½ - 16	.3' porous gyp with free gasoline. 1.2' gyp sli por gasoline odor. Tr gray clay
16 - 17½	1' gyp & lst gravel with gasoline. .5' gyp no odor
17½ - 19	gyp & lst gravel - water
19 - 19½	Drill gyp
19½ - 21	1.2' gravel & gyp;water. .3' dry gravel - solid
21+	No go core. Rec. ± .25' very crs gravel & gyp



−19 wtr

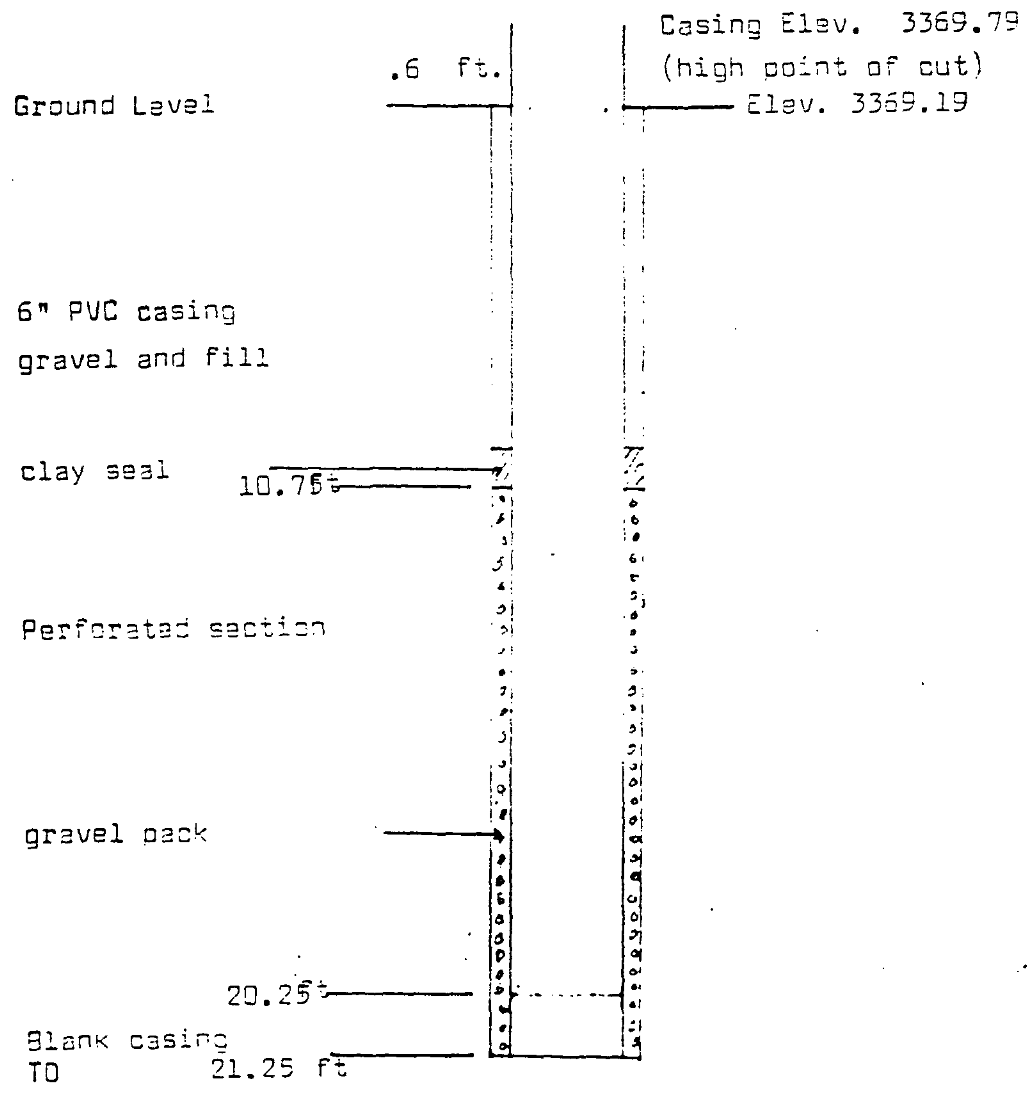
−10

3

DETAILS OF WELL CONSTRUCTION

Date 6/8/93 Well # 22

Company Navajo Refining



SAMPLE LOG

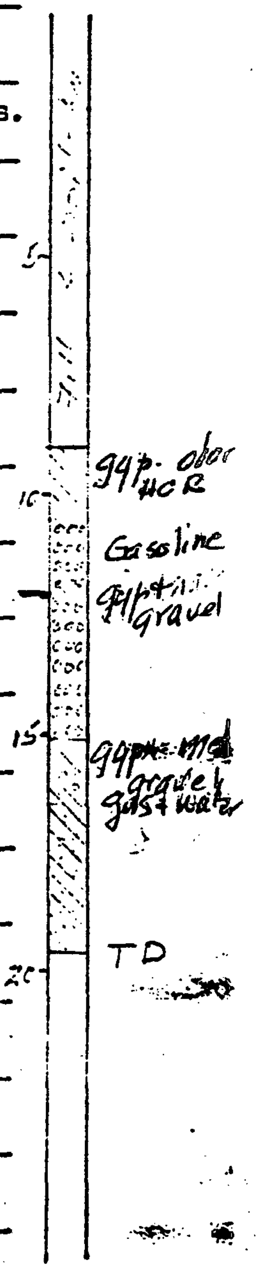
Well # A8 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/9/83 7:15 am

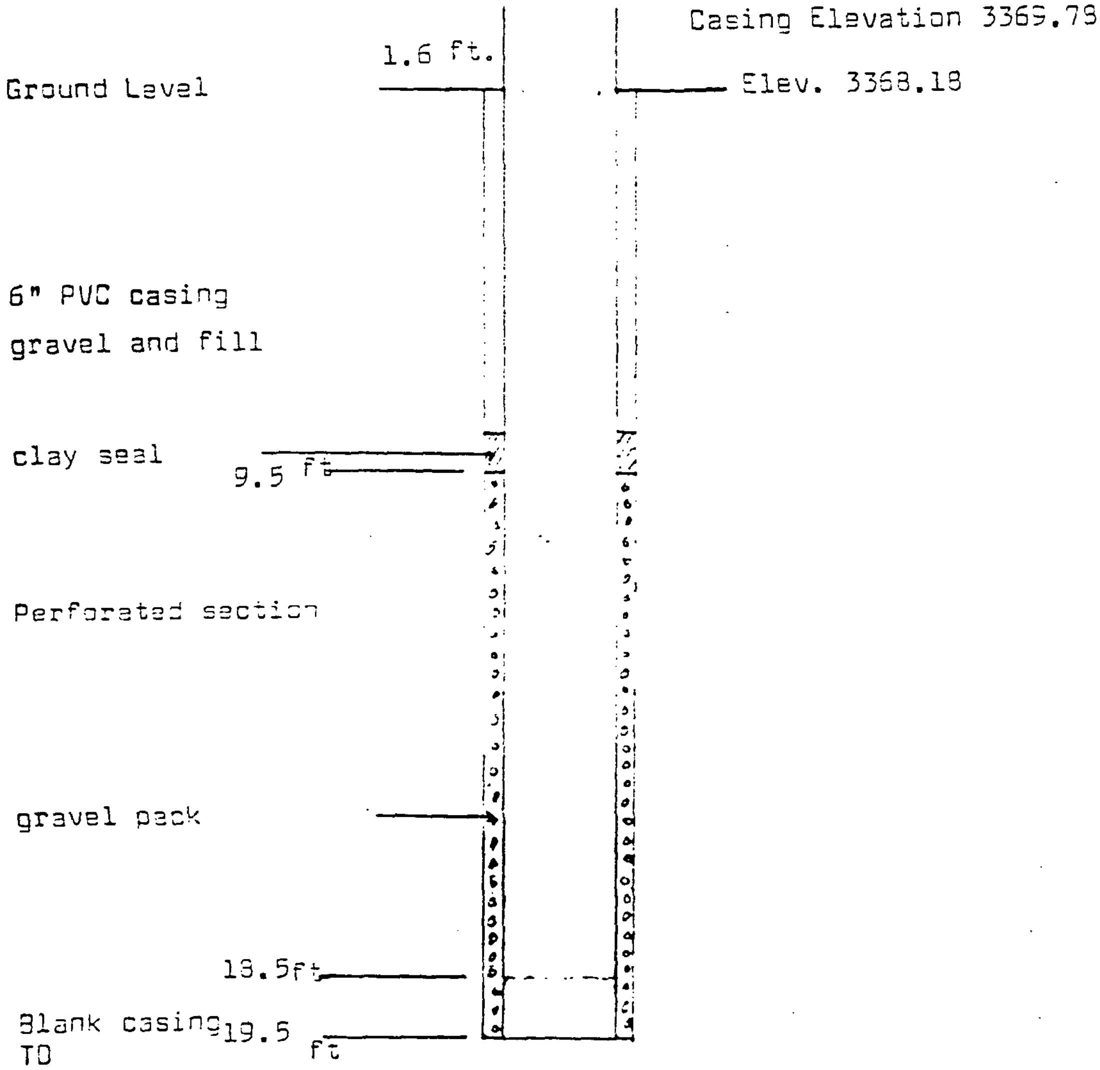
Depth	Sample description
0 - 9	Soil - Fill - Red
9 - 10½	dk. gry gyp & clay with 1st pebbles and blk HCR seams. sli gas odor
10½ - 12	gravel (crs 1st pebbles in gyp) free gasoline
12 - 13½	crs. 1st pebbles in gyp free gasoline
13½ - 15	crs 1st pebbles in gyp free gasoline
15 - 16½	gyp & med gravel - gasoline & water
16½ - 19½	Drill gyp & gravel
	Top Gasoline 1st trench
	-16.5 wtr
	-11.34 Top fill 7/83
	5.16



DETAILS OF WELL CONSTRUCTION

Date 6/9/93 Well # A3

Company Navajo Refining



SAMPLE LOG

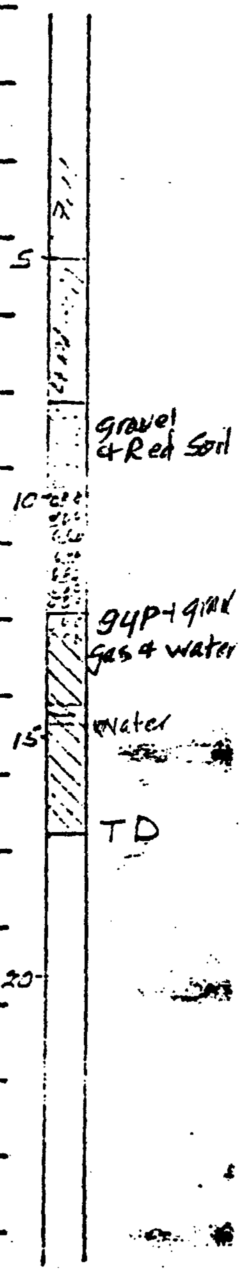
Well # AC   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/9/83 10 am

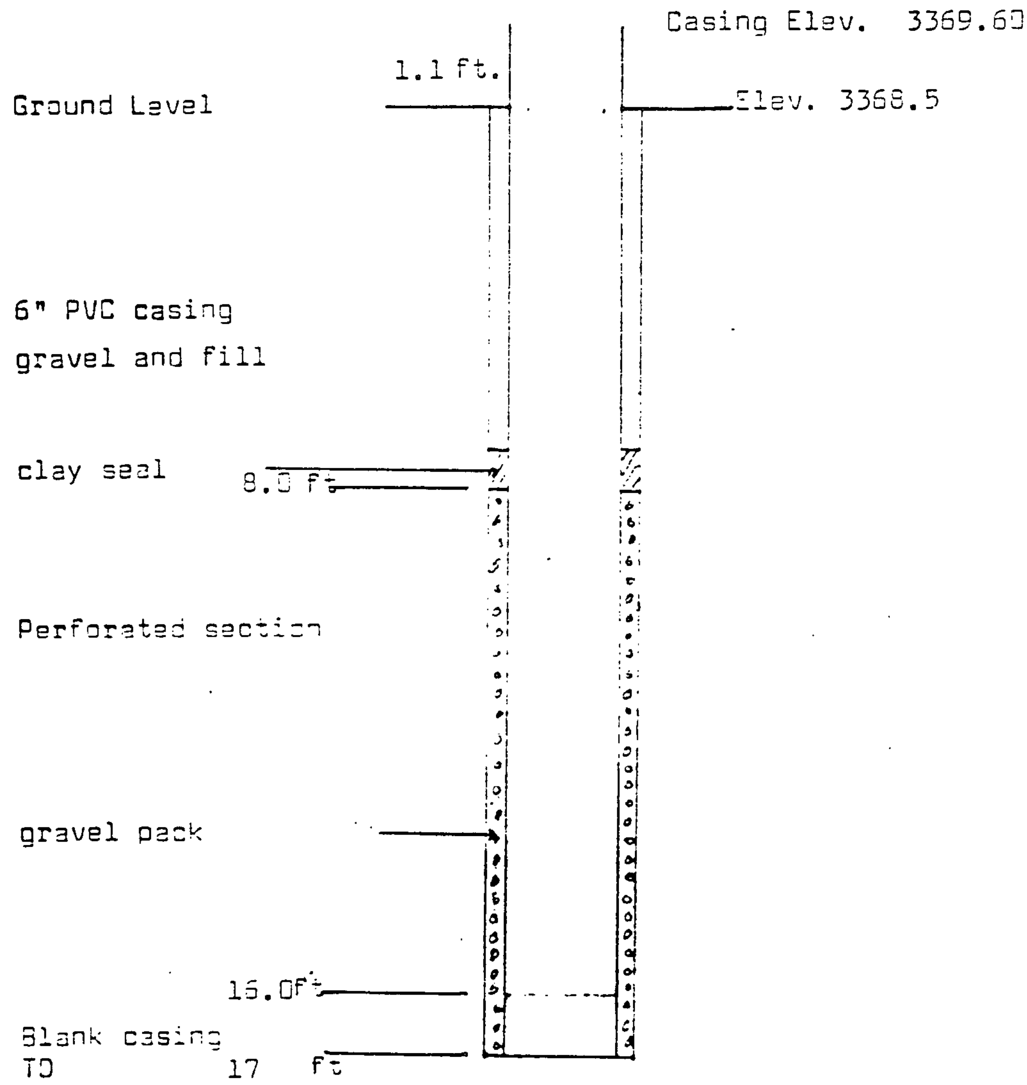
Depth	Sample description
0 - 5	Fill dirt. Top lt red soil @ 5'
5 - 8	Lt red soil. Top gravel @ 8'
8 - 10	gravel & red soil
10 - 12½	gravel & red soil or clay - top gyp gas odor
12½ - 13	Drill gyp
13 - 14½	.5' gyp w gas & water some gry clay 1' gyp
14½ - 15½	gyp & gry clay. Sli gravel 14½-¾ water
15½ - 17	1.4' gyp wet .1' dry gyp
	- 14.75 wtr
	- 15.47 [illegible]
	4.72



DETAILS OF WELL CONSTRUCTION

Date 6/9/83 Well # AC

Company Navajo Refining



SAMPLE LOG

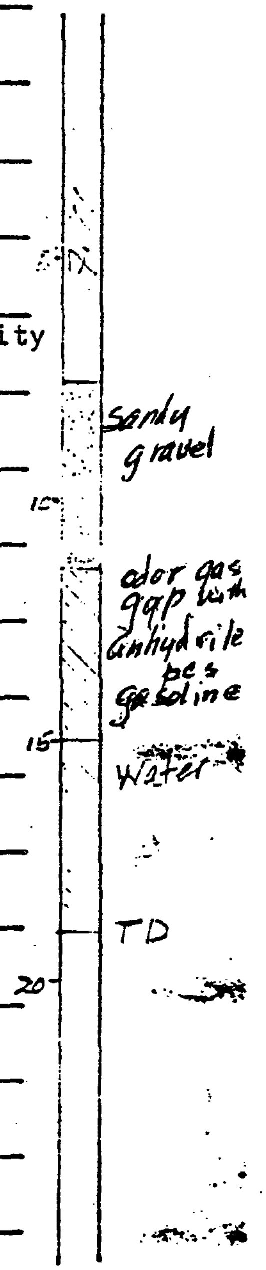
Well # AD   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/9/83 1:55 pm

Depth	Sample description
0 - $7\frac{1}{2}$	Fill
$7\frac{1}{2}$ - $11\frac{1}{2}$	Sandy gravel
$11\frac{1}{2}$ - 12	Drill gyp odor gas
12 - $13\frac{1}{2}$	gyp w 1st pebbles (gravel) gasoline - fair porosity
$13\frac{1}{2}$ - 15	gyp w anhydrite pcs - no gravel. Fair to poor porosity Odor gasoline 1' - No odor bottom .5'
15 - $16\frac{1}{2}$	gyp w anhydrite pcs - water
$16\frac{1}{2}$ - $17\frac{1}{2}$	gyp w anhydrite pcs - water
$17\frac{1}{2}$ - 19	gyp TD



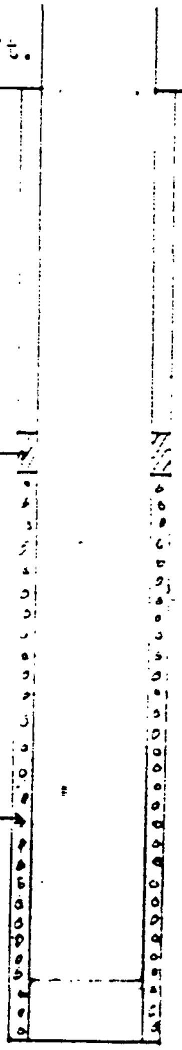
DETAILS OF WELL CONSTRUCTION

Date 6/9/83 Well # 10

Company Navajo Refining

Casing Elev. 3370.59

Ground Level 1.6 ft. Elev. 3368.99



6" PVC casing

gravel and fill

clay seal 9.0 ft

Perforated section

gravel pack

18.0 ft

Blank casing

TD 19 ft

SAMPLE LOG

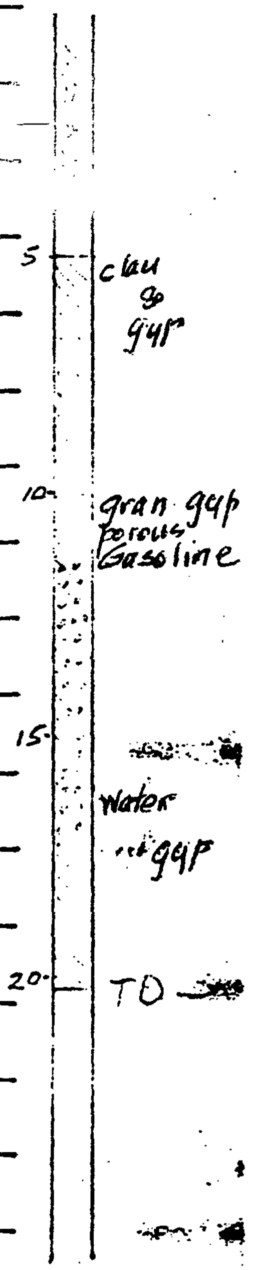
Well # AE Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/10/83 7:15 am

Depth	Sample description
0 - 5	Fill & soil
5 - 7	Gry clay & gyp
7 - 9	Gry clay & gyp - change at bottom
9 - 10	Drill
10 - 11¼	granular gyp & anhy .8'. porous gyp .45' gasoline in whole core
11¼ - 12.7	med gravel & gyp - porous gasoline
12^{7} - 14^{2}	1' med gravel & gyp. .5' gran gyp. gasoline
14^{2} - 15	gravel & gyp gasoline
15 - 16½	1' grav seams in gyp. .9' gyp w water
16½ - 18	¾' gravel & gyp w water. ¾' tight gyp
18 - 18^{8}	hard gyp
18^{8} - 20^{3}	Drill hard gyp

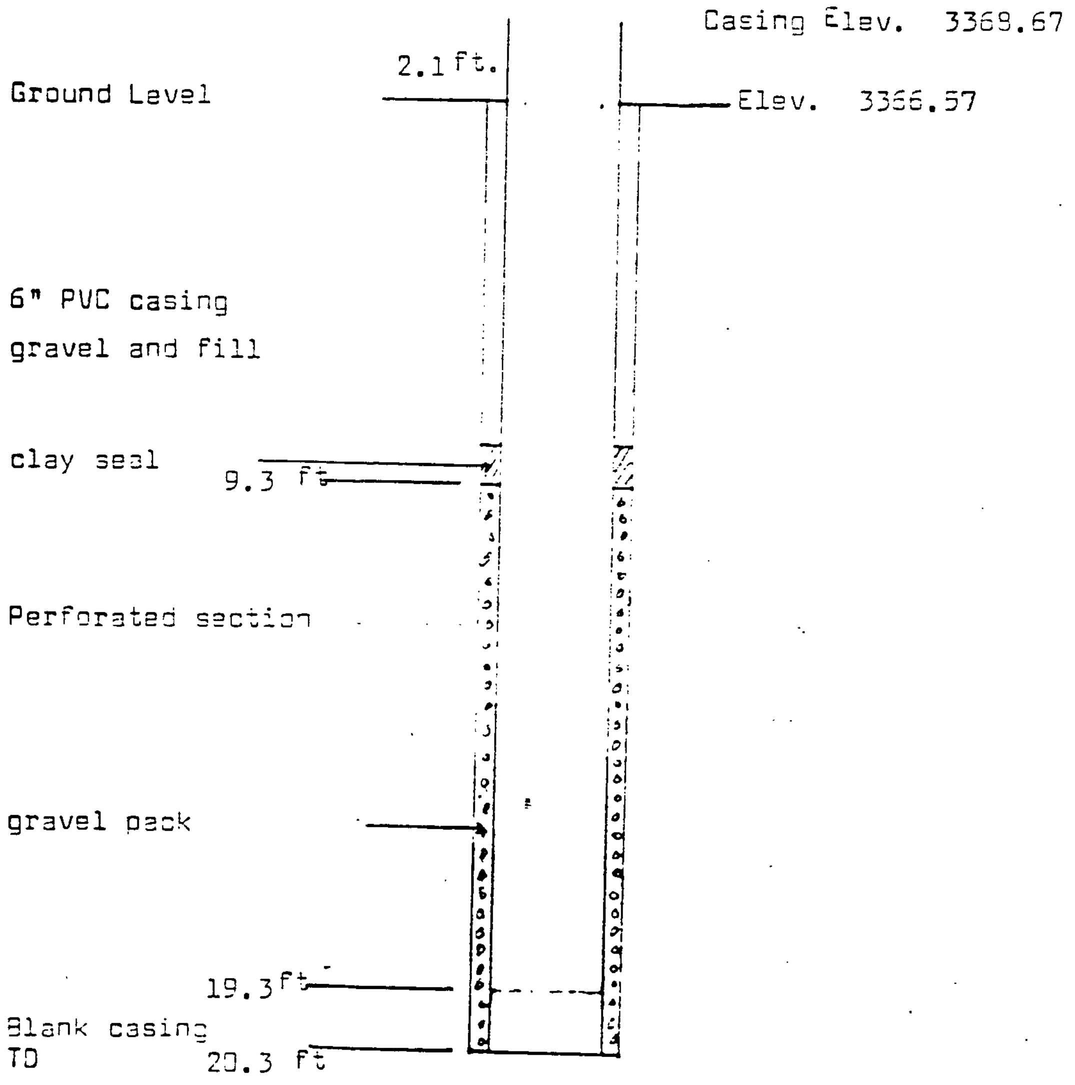


RECEIVED
MAR 06 1985
OIL CONSERVATION DIVISION
SANTA FE

DETAILS OF WELL CONSTRUCTION

Date 6/10/83　　　　　　　　Well # AE

Company Navajo Refining



SAMPLE LOG

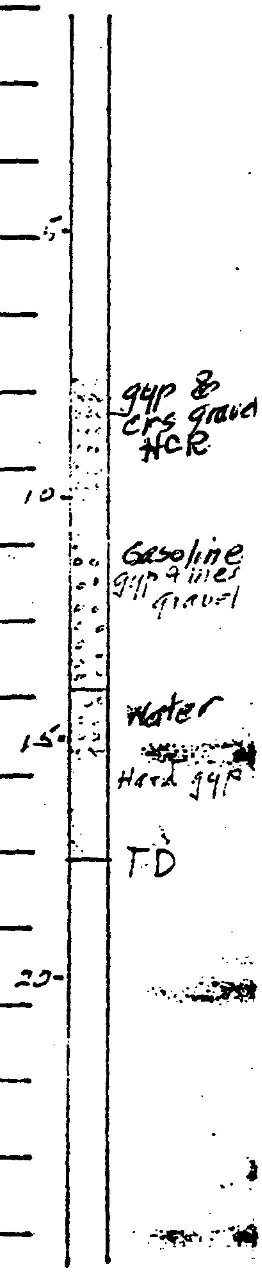
Well # AF Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/10/83 10:30 am

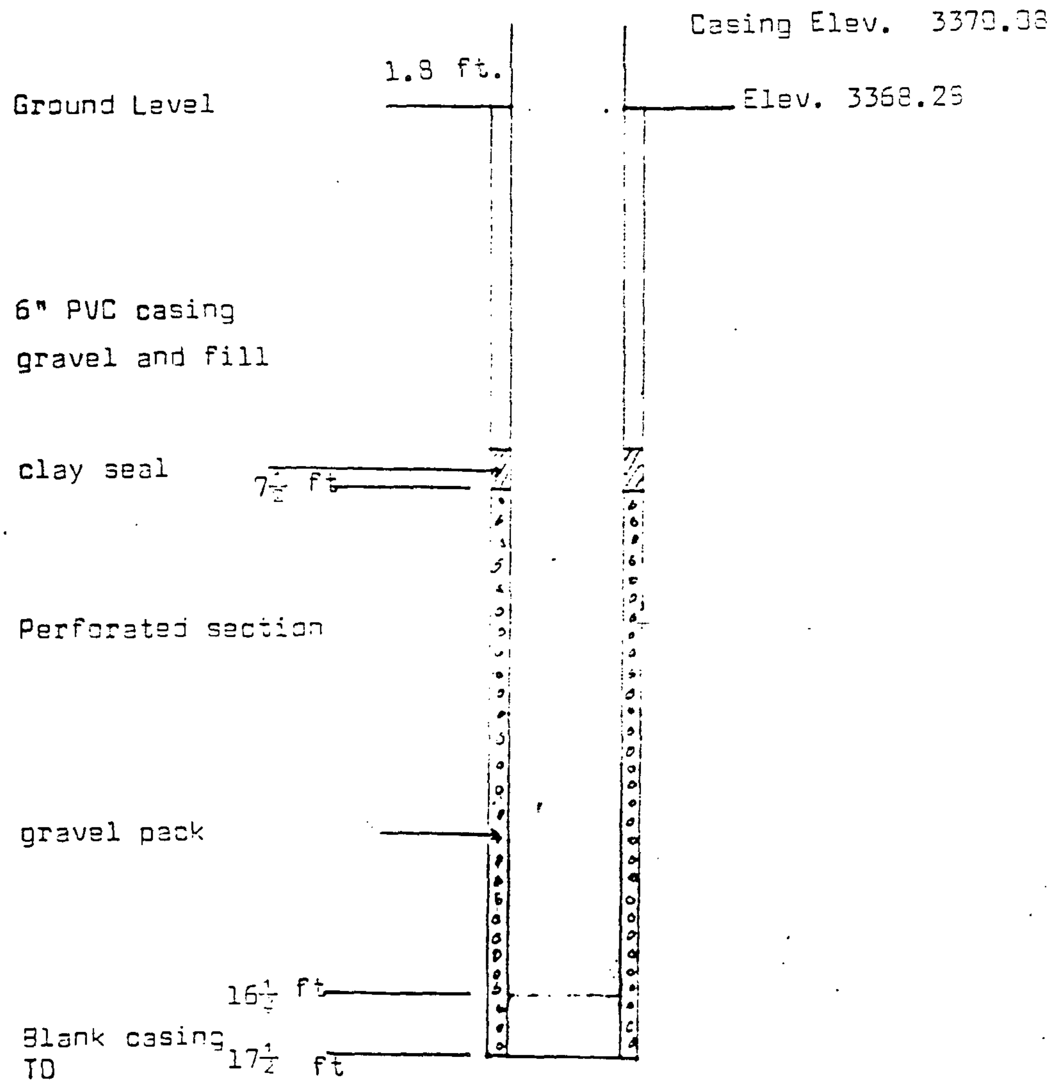
Depth	Sample description
0 - $7\frac{1}{2}$	Fill - $7\frac{1}{2}$' top gry clay (gyp) & pebbles
$7\frac{1}{2}$ - 11	HCR stained gyp w crs pebbles Top gasoline section
11 - $12\frac{1}{2}$	gry gyp w med gravel - gasoline saturated
$12\frac{1}{2}$ - 13	gry gyp w med gravel - gasoline saturated
13 - $13\frac{1}{2}$	Drill gyp & gravel
$13\frac{1}{2}$ - 14	Drill gyp
14 - $15\frac{1}{2}$	gry gyp w med gravel 1.2' water. Hard gyp .3'
$15\frac{1}{2}$ - $17\frac{1}{2}$	Drill gyp



DETAILS OF WELL CONSTRUCTION

Date 6/10/93 Well # 8F

Company Navajo Refining



SAMPLE LOG

Well # AG   Navajo Refining Company - Monitor wells

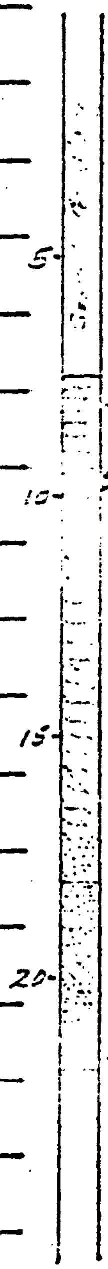
Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger   8" diameter   Split spoon core barrel 18"

Date 6/10/83   3:00 pm

Depth   Sample description

0 - 7½	gravel & clay
7½ - 9	gyp & clay - tight
9 - 10½	gyp & clay - slight odor. Tight clay last ¾'
10½ - 12	gyp and gry clay no fluid
12 - 13½	gyp & gry clay " "
13½ - 15	gyp & gry clay " "
15 - 16½	gry clay & gyp " "
16½ - 18	gry clay & gyp .5'. gry sand 1' sli wet at bottom
18 - 19½	gry sand 1.4' gyp & gry clay .1' fluid in ss water
19½ - 20	drill gyp
20 - 21½	.6' sand wet .9' gyp & clay water
21½ - 22	Drill to TD



gyp & clay
No fluid
sl. odor gas

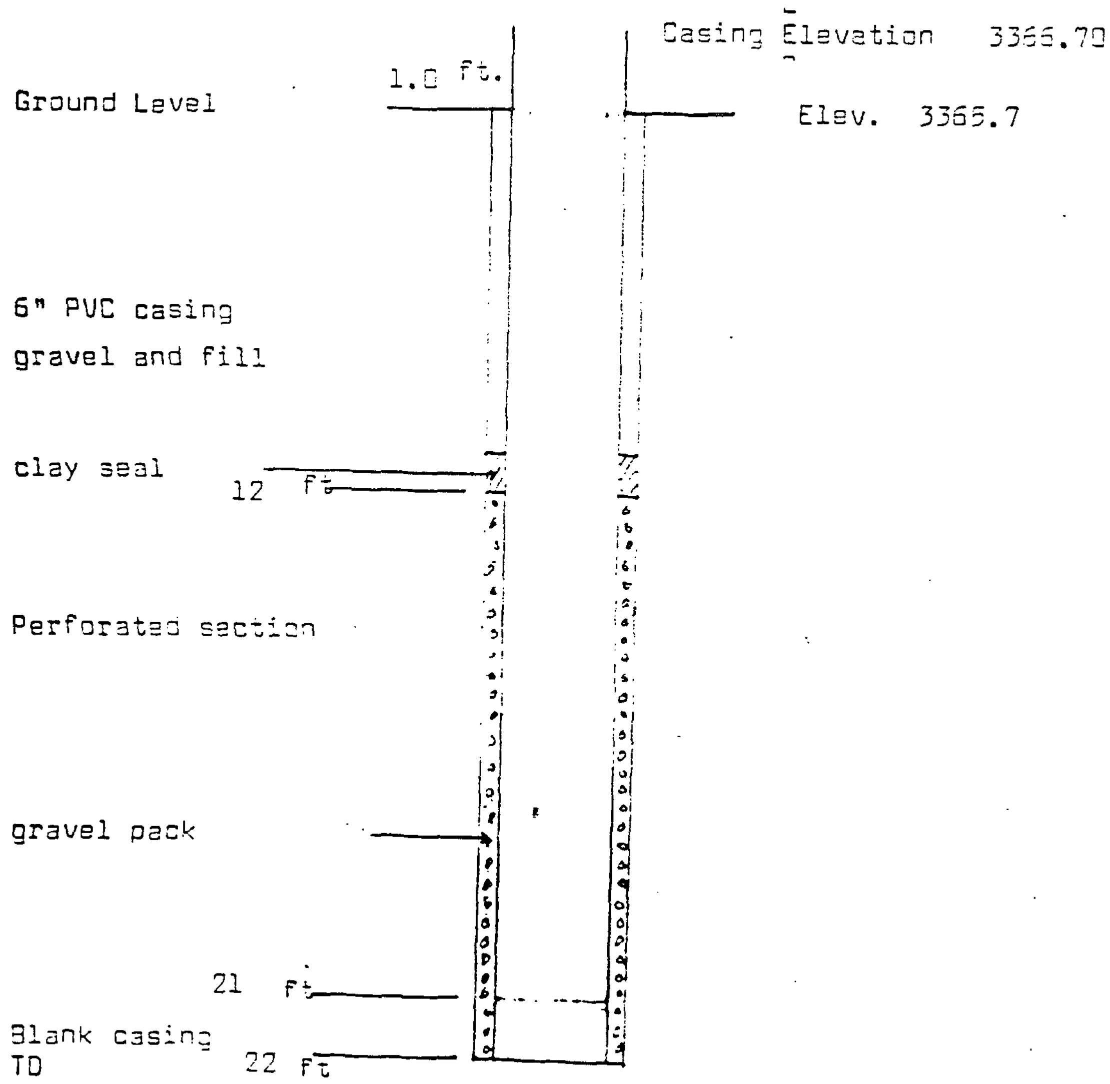
sand
water

ss water

DETAILS OF WELL CONSTRUCTION

Date 6/10/83 Well # [illegible]

Company Navajo Refining



SAMPLE LOG

Well # AH   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

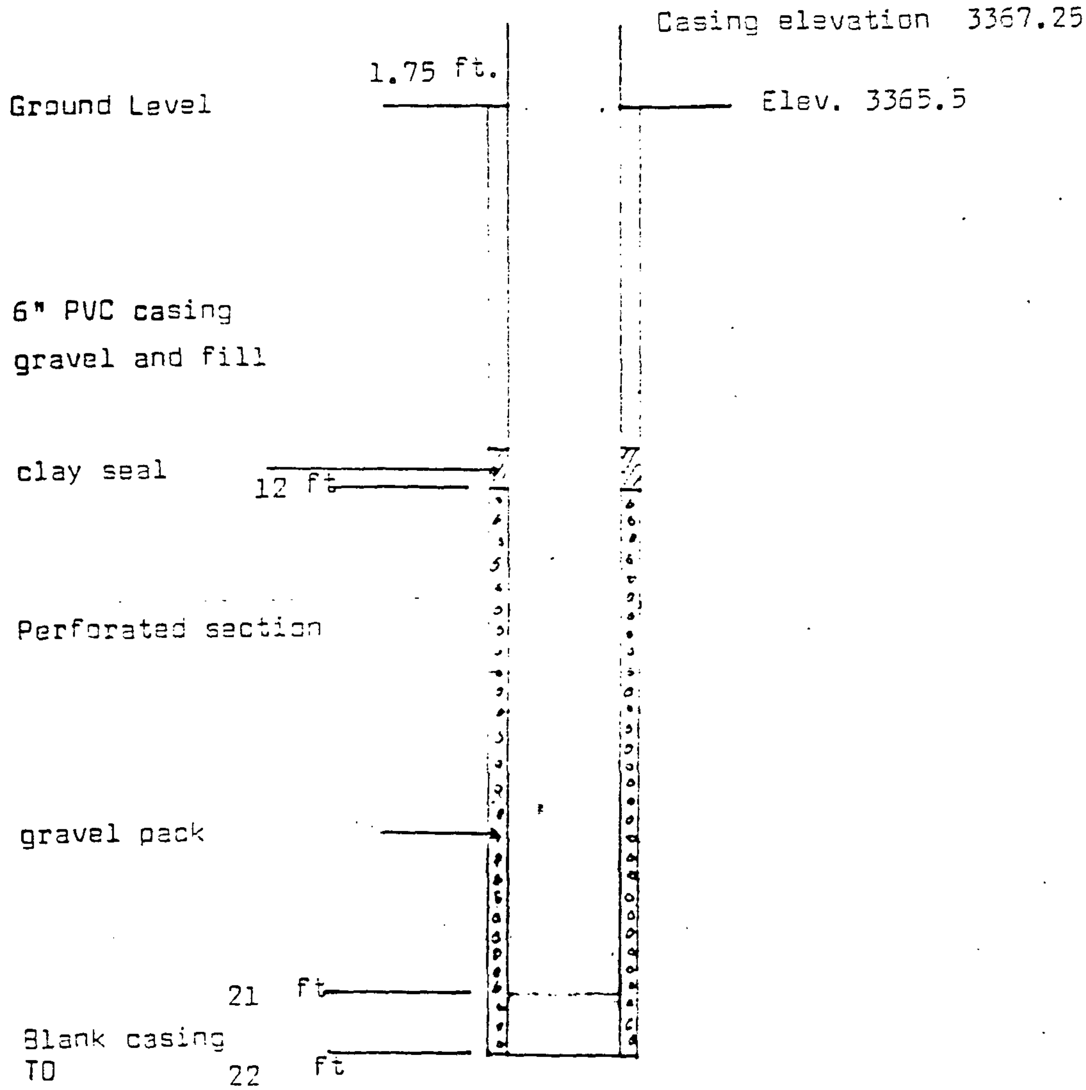
Date 6/11/83 7:30 am

Depth	Sample description	
0 - 4½	Crs gravel fill & valley fill	
4½ - 5	gry clay & gyp	
5 - 6½	Pnk sdy clay & gravel	
6½ - 8	Crs gravel & gyp	gyp & gravel
8 - 9½	gyp - dry - no gravel	
9½ - 11	gyp & gry shale - no gravel	No gravel gyp
11 - 12½	gravel & gran. gyp & gry shale. Tr fluid odor gas	No gravel
12½ - 14	.2' gravel, gyp & gry shale. 1.3' med gravel & gyp no free fluid	
14 - 15½	gyp, gry shale & gravel zones .1' thick. sli odor no fluid	
15½ - 17	gyp, gry shale - dry. Tr sand on bottom	
17 - 18.5	clay & gyp sli wet	dry
18½ - 20	lt red clay & gyp - water	
20 - 20½	Drill	Water
20½ - 22	clay & gyp - tight - no fluid. Red shale on bottom	
	TD	TD

DETAILS OF WELL CONSTRUCTION

Date 6/11/83 Well # AH

Company Navajo Refining



SAMPLE LOG

Well # AI Navajo Refining Company - Monitor wells

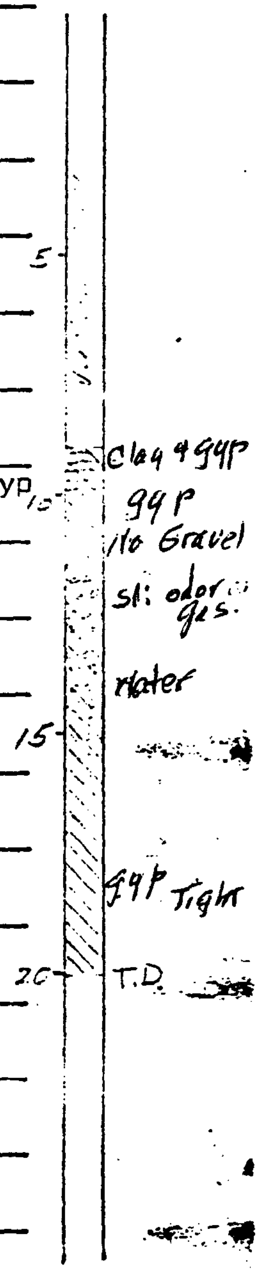
Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/11/83 10:35 am

Depth Sample description

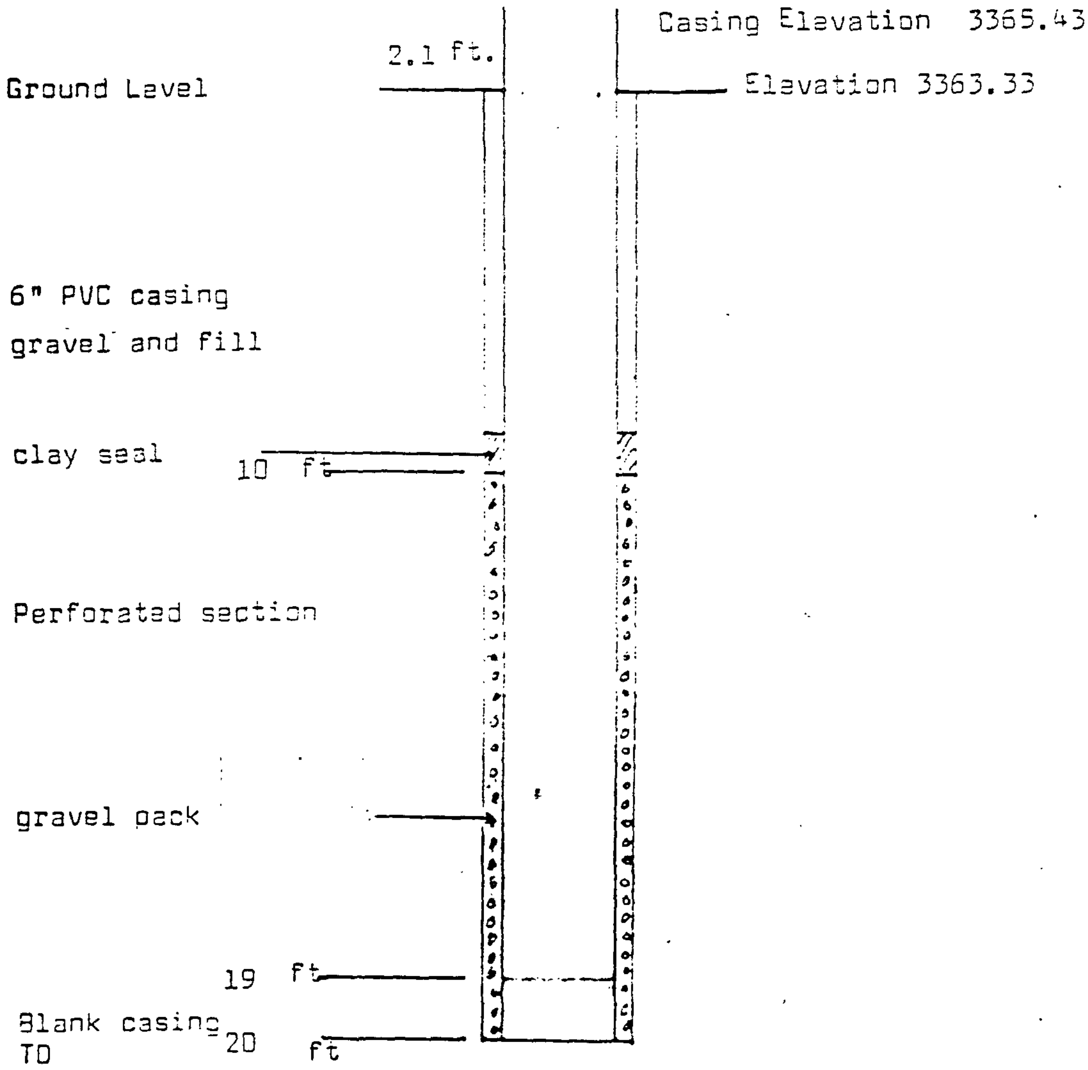
0 - 9	Valley fill
9 - 10½	clay & gyp - no fluid; no gravel
10½ - 12	1' clay & gyp. .5' gyp & gravel odor gas
12 - 13½	1' gyp & gravel - sli odor- damp. .5' hard dry gyp
13½ - 15	.5' gyp & gravel - water ; 1' red clay & gyp dry
15 - 15½	Drill
15½ - 17	¾' gyp & red clay w gravel - wtr. ¾' dk gry clay & gyp w gravel
17 - 18	gyp w little gravel at top. Balance tight
18 - 20	Drill TD



DETAILS OF WELL CONSTRUCTION

Date 6/11/83 Well # 9I

Company Navajo Refining



SAMPLE LOG

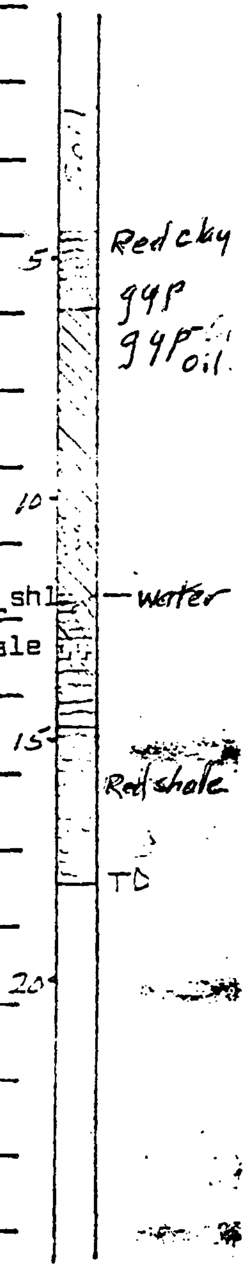
Well # R   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger   8" diameter   Split spoon core barrel 18"

Date 6/7/83   10:15 am

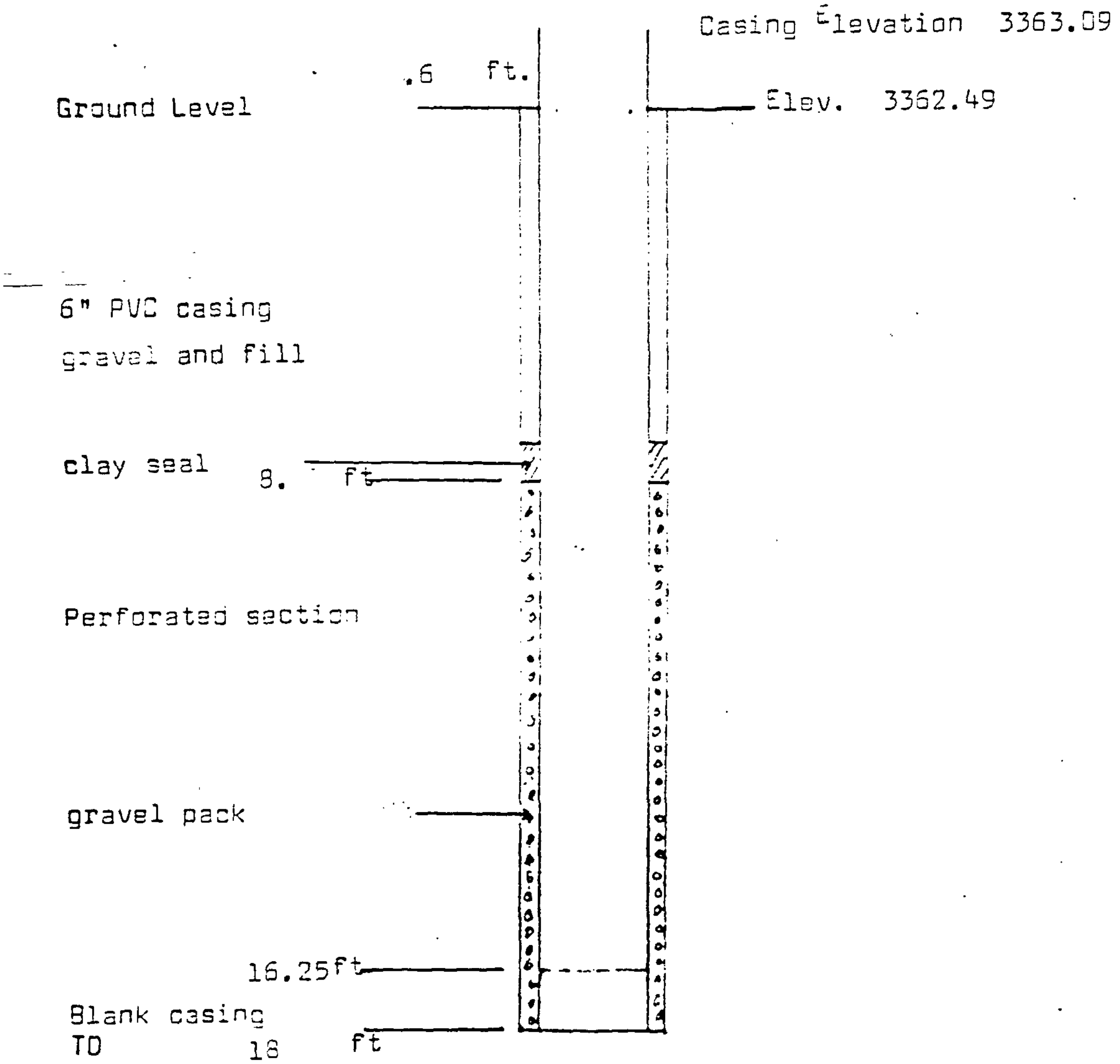
Depth	Sample description
0 - 4½	Red soil
4½ - 6	Red clay & gyp no porous zone
6 - 7½	gyp & anhydrite - 1¼': gyp ¼' w oil odor
7½ - 8¾	gyp & anhy - oil stained - sli porosity
8¾ - 9	drill
9 - 10½	1' oil wet gyp - porous. .5' tight gyp oil odor
10½ - 12	.7' dk gry gyp & gravel wet - oil - .5' dk gry gyp & gravel sli wet: .3' gry & rd shly gyp
12 - 13½	¼' red gravelly shale - water: .5' gry gyp water: .3' red anhy, gravel dry odor: .4' rd hard limey shl wtr
13½ - 15	.4' rd-gry shly gyp: .9' gravel w water: .2' red shale
15 - 16½	.7' red shale
16½ - 18	Red shale TD



DETAILS OF WELL CONSTRUCTION

Date 6/7/83 Well # 8

Company Navajo Refining



SAMPLE LOG

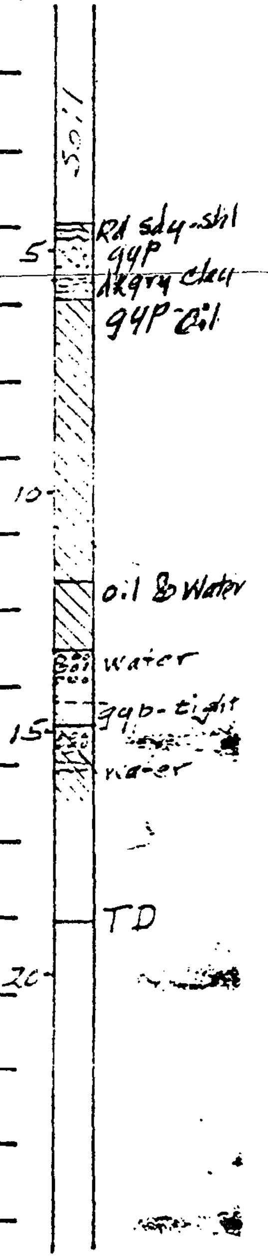
Well # 5 Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger 8" diameter Split spoon core barrel 18"

Date 6/7/83 3:05 pm

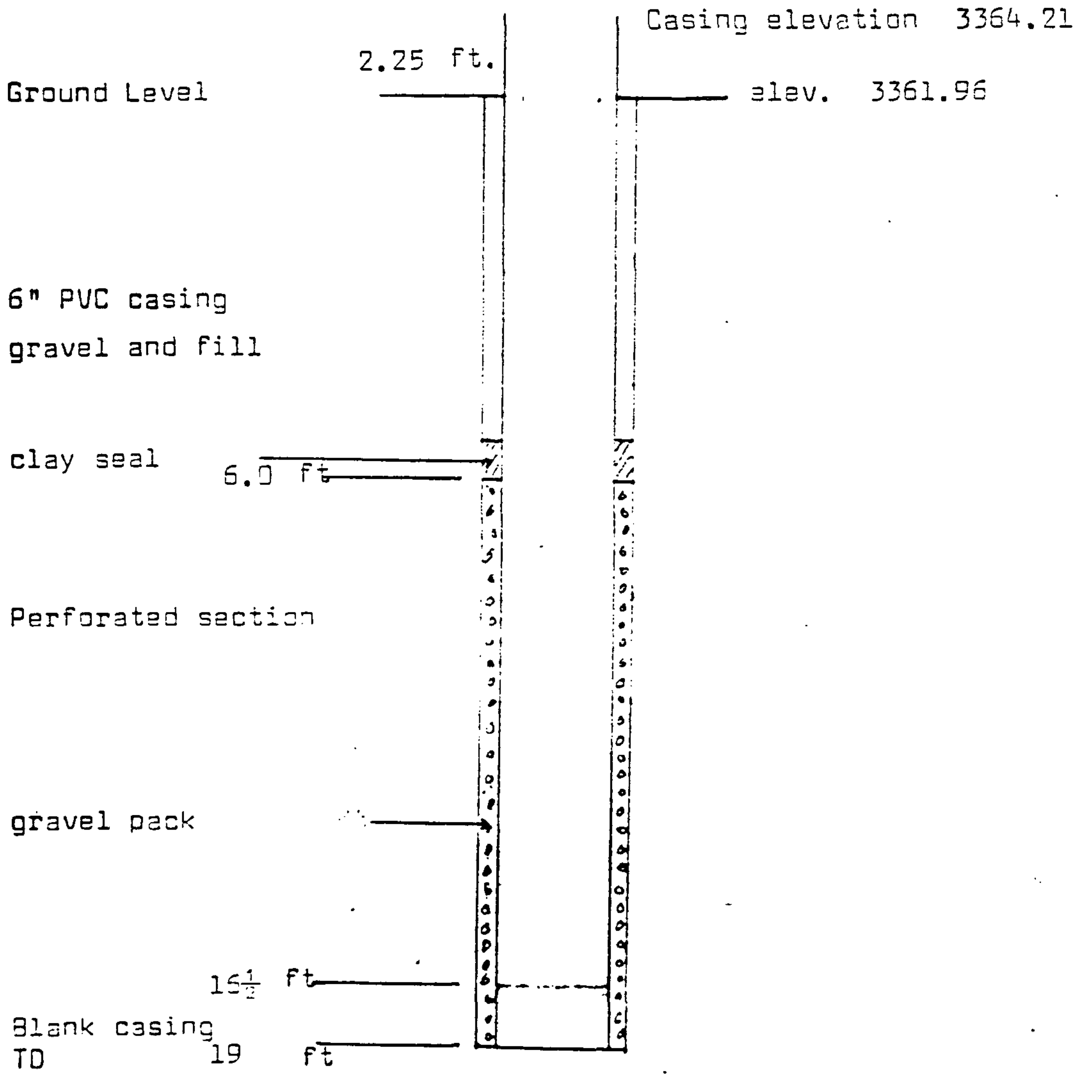
Depth	Sample description
0 - 4½	Soil
4½ - 6	Lt rd sdy gyp dry .7' : dk gry clay .8'
6 - 7½	gy shl & gyp - oil stain & odor
7½ - 9	dk gy shly gyp ¼' oil stn & odor : 1¼' lt gy shly gyp oil odor
9 - 10½	lt & dk gy shly anhy & gyp - granular - bldg oil
10½ - 12	drill
12 - 13½	lt & dk gy shly gyp, sli porous - oil & wtr
13½ - 15	lt gy gravel 1' w wtr : lt gy gyp w oil & wtr .5': at bottom tight.
15 - 16½	gravel, clay & gyp - water
16½ - 19	Drill to TD



DETAILS OF WELL CONSTRUCTION

Date 6/7/83 Well # 9

Company Navajo Refining



SAMPLE LOG

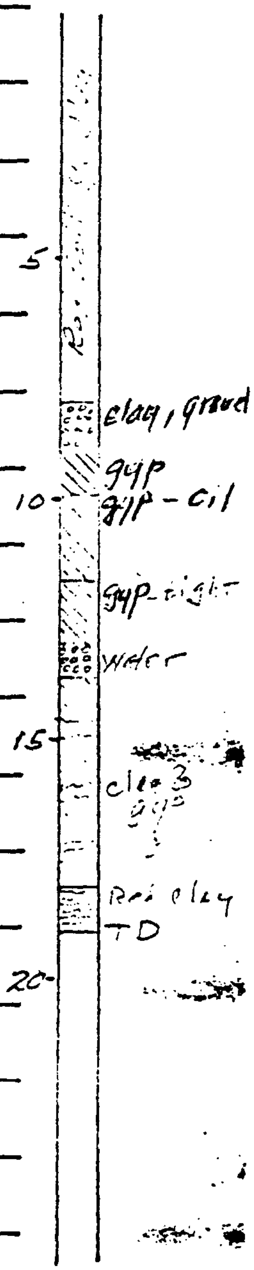
Well # T   Navajo Refining Company - Monitor wells

Drilling Contractor - D. Anderson, El Paso

Rig - Hollow stem auger   8" diameter   Split spoon core barrel 18"

Date 6/8/83   8:45 am

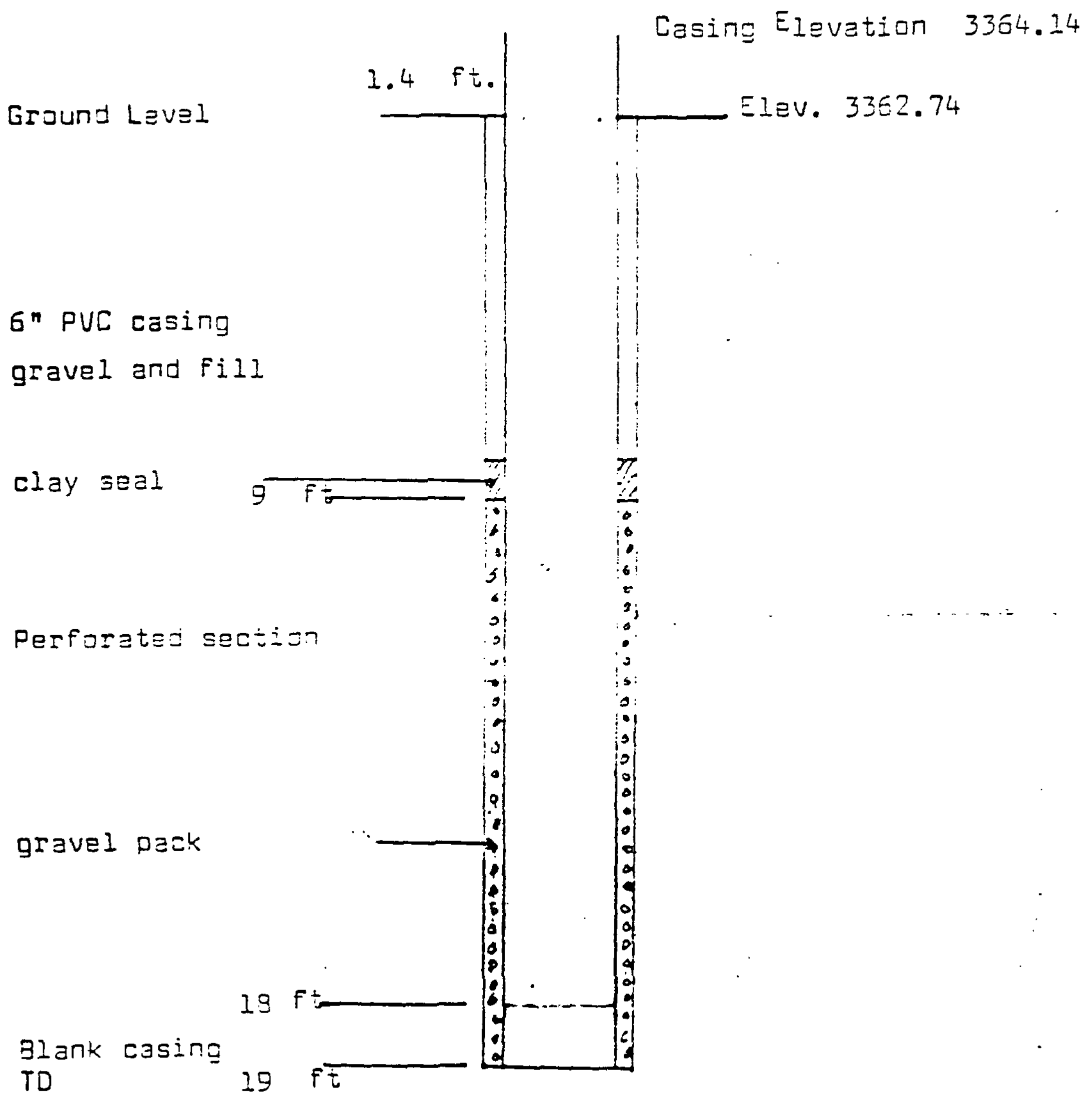
Depth	Sample description
0 - 8	Red soil - clay
8 - 10	Pnk clay w gravel - valley fill 1' : .5' gyp
10 - 11½	gyp + .15': gry clay & gravel + 1. : .15' dk gy gyp
11½ - 13	¼' dk gry gyp, oil odor, core bbl wet w oil : 1¼' gy gyp sli odor tight
13 - 13¾	lt gy gyp & gravel - water - core blocked
13¾ - 18	dk gy clay & gyp
18 - 19	Red clay TD



DETAILS OF WELL CONSTRUCTION

Date 6/3/93 Well # T

Company Navajo Refining



WELL LOGS USED ON THE
EAST - WEST CROSS SECTION

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well City of Artesia

Street and Number

City Artesia State N.M.

Well was drilled under Permit No. and is located in the

¼ NW ¼ NE ¼ of Section 17 Twp. 17 Rge. 26

(B) Drilling Contractor Gesler & Slocumb License No.

Street and Number

City State

Drilling was commenced June 21 19 09

Drilling was completed Aug. 24 19 09

Elevation at top of casing in feet above sea level Total depth of well 968

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

Section 2

PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	To	Thickness in Feet	Description of Water-Bearing Formation
1				1st flow 890'
2				2nd flow gradual increase 890-920
3				
4				
5				

Section 3

RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Bottom	Feet	Type Shoe	Perforations From	To
11 5/8					121			
8					727			
6					211			
	Packer between 6" x 8"							

Section 4

RECORD OF MUDDING AND CEMENTING

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

Section 5

PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

from driller's log 12-6-62

File No. Use Location No. 17.26.17.210

Section 6

LOG OF WELL

Depth in Feet From	To	Thickness in Feet	Color	Type of Material Encountered
0	13			soil
13	30			rock
30	40			sand
40	100			gyp
100	121			sand
121	141			rock
141	205			shale
205	228			rock
228	698			shale
698	768			rock
768	830			shale
830	856			rock
856	877			shale
877	890			rock
890	920			water rock, hard
920	968			Rock-hard

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

Well Driller

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well Albert F. Woods,

Street and Number

City Artesia State New Mexico

Well was drilled under Permit No. ____ and is located in the ____ ¼ NW ¼ NW ¼ of Section 16 Twp. 17S Rge. 26E

(B) Drilling Contractor M.S.Bruning License No.

Street and Number

City State

Drilling was commenced April 15, 1930

Drilling was completed June 1, 1930

Elevation at top of casing in feet above sea level ____ Total depth of well 1233'

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
12½	50		0	1233	1233			

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____

Street and Number ____ City ____ State ____

Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____

Plugging method used ____ Date Plugged ____ 19__

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-1090 Use ____ Location No. 17.26.16.110

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered
From	To			
0	15	2255		soil
15	30	3340		gyp
15	30			gyp
30	35	3395		sand
35	450	[illegible]		gyp and clay
450	460			gyp rock
460	490			sandy shale and gyp stratas
490	690			sandy sahle and gyp stratas
690	710			rock
710	740			red sand
740	770			rock
770	820			red sand
820	840			rock lime
840	876			shale
876	912			lime rock
912	913			water rock
913	958			lime rock
958	960			water rock
960	996			lime rock
996	1000			water rock
1000	1027			lime rock
1027	1032			water rock
1032	1058			lime rock
1058	1060			water rock
1060	1118			lime rock
1118	1132			water rock
1132	1218			lime rock
1218	1220			water rock
1220	1232			lime rock

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

Well Driller

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Fred Jones Owner's Well No. RA-6612
Street or Post Office Address P.O. Box 423
City and State Artesia, NM 88210

Well was drilled under Permit No. RA-6612 and is located in the:

a. SE ¼ SW ¼ NE XXX SE ¼ of Section 9 Township 17S Range 25E N.M.P.M.

b. Tract No. ______ of Map No. ______ of the Hilcrest acre subdivision

c. Lot No. 3 of Block No. ______ of the Drilled east center of lot
Subdivision, recorded in ______ County.

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

(B) Drilling Contractor H & W Enterprises License No. WD-675

Address P.O. Box 437 Artesia, NM 88210

Drilling Began 4-7-80 Completed 4-21-80 Type tools Cable Size of hole 7" in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 325 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 235 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
273	303	30	Fine snad and gravel	8½

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
7"	26	PE	1	302	303	PE	273	303

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:
______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received April 30, 1980

Quad ______ FWL ______ FSL ______

✓ File No. RA-6612 Use Dom. Location No. 17.26.9.34430
Temp. on SW Corner

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered (3365' GL)
0	10	10	Top Soil 3355
10	70	60	Gypsum 3295
70	190	120	Gypsum and clay sand 3175
190	240	50	Clay 3125
240	270	30	Clay and Sand 3095 [illegible]-293
270	290	20	Fine Gravel and Sand 3075 [illegible] - 3073
290	325	35	Fine Gravel clay Red Bed TD 3040

'80 APR 30 AM 8 05
STATE ENGINEER OFFICE
ROSWELL, N.M.

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Tony Hall
Driller

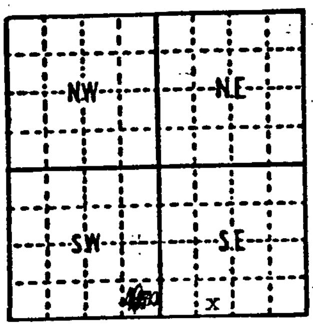
INSTRUCTIONS: This fo[illegible] should be executed in triplicate, preferably typewritten, and submitted t[illegible]e appropriate district office of the State Engineer. A[illegible] tions, except Section 5, shall be answered as completely and accura[illegible] possible when any well is [illegible] When this form is used as a plugging record, only Section 1(a) and Section [illegible] need be completed.

L.B.

WELL RECORD

File No.

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, P. O. Box 1079, Santa Fe, New Mexico, or in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.



(Plat of 640 Acres)
Locate Well Accurately

Owner of well Britton Coll

Street and Number Rt. 1 Box 30

Post Office Artesia New Mexico

Well was drilled under Permit No. RA-2723 and

is located in the SE ¼ SW ¼ SE ¼ of Section 9

Township 17 South, Range 26 EASt

Drilling Contractor Blount & Coll

Street and Number Rt. 1 Box 30

Post Office Artesia New Mexico

Drilling was commenced July 9, 19 51. Drilling was completed July 23 1951, 19

Elevation at top of casing in feet above sea level 3355

State whether well is shallow or artesian Shallow, Domestic

Total depth of well 318 feet. Water level upon completion of well 40 feet below land surface.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from 240 to 318, Thickness in feet 78, Formation Sand rock

No. 2, from to, Thickness in feet, Formation

No. 3, from to, Thickness in feet, Formation

No. 4, from to, Thickness in feet, Formation

No. 5, from to, Thickness in feet, Formation

Sec. 3 RECORD OF CASING

Diameter in Inches	Pounds per Foot	Threads per Inch	Name of Manufacturer	Feet of Casing	Type of Shoe	Perforated From	Perforated To	Purpose
7" OD				240				
5" OD	Perforated			85				Liner

Sec. 4 RECORD OF MUDDING AND CEMENTING

Diameter of Hole in Inches	Number of Sacks of Cement	Methods Used	Specific Gravity of Mud	Tons of Clay Used

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ¼ ¼ ¼ of Section, Township,

Range Name of plugging contractor

Street and Number Post Office

Tons of clay used Tons of roughage used Type of roughage

Was plugging approved by Artesian Well Supervisor?

Cement plugs were placed as follows:

No. 1 was placed at feet. Number of sacks of cement used

No. 2 was placed at feet. Number of sacks of cement used

No. 3 was placed at feet. Number of sacks of cement used

No. 4 was placed at feet. Number of sacks of cement used

No. 5 was placed at feet. Number of sacks of cement used

(over)

RA-2723 17.26.9.434

Sec. 6

LOG OF WELL

From (Depth in Feet)	To (Depth in Feet)	Thickness in Feet	Classification of Formation
	3355.84		
0 - 30	3325		Surface & clay
30 - 40	3315		gravel & gyp
40 - 164	3191		clay & gyp
164 - 200	3155		sand rock
200 - 225	3130		loose sand
225 - 260	3095		shells & clay
260 - 274	3081		clay
274 - 318	3037		sandrock & clay

I, ______________________________, do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this 7 day of August A.D., 1951

Gene Dallas
Notary Public

My Commission Expires 10 Aug. 1952

Signed Britton Call

Position Driller

Street and Number Route 1, Box 30

Post Office Artesia, New Mexico

Form WR-23 FIELD F[illegible]R. LOG STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well Bruce Harris

Street and Number Box 842

City Artesia State New Mexico

Well was drilled under Permit No. RA-4196 and is located in the SW ¼ SW ¼ SW ¼ of Section 10 Twp. 17-S Rge. 26E

(B) Drilling Contractor Willard Beaty License No. WD-62

Street and Number 1102 Merchant

City Artesia State New Mexico

Drilling was commenced April 26 19 60

Drilling was completed May 12 19 60

Elevation at top of casing in feet above sea level [illegible] Total depth of well 294

State whether well is shallow or artesian Shallow Depth to water upon completion 80

Section 2

PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	280	292	12	Sand & Gravel
2				
3				
4				
5				

Section 3

RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7"OD	20	8 Round		294	294	Steel	275	294

Section 4

RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
		8"			

Section 5

PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

DISTRICT II
STATE ENGINEER OFFICE
1960 JUN -8 AM 8:19

File No. RA-4196 Use Dom Location No. 17.26.10.333

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered 3350
0	2	2	Brown	Top Soil 3348
2	25	23	Red	Clay 3325
25	30	5	Gray	Gravel 3320
30	40	10	Red	Clay 3310
40	70	30	Red	Sandy Clay 3280
70	140	70	Red	Clay 3210
140	160	20	Brown	Sand 3190
160	200	40	Red	Clay 3150
200	240	40	Brown	Sand 3110
240	250	10	Red	Clay 3100
250	270	20	Brown	Sand 3080
270	280	10	Red	Clay 3070
280	292	12	Brown	Sand & Gravel 3058
292	294	2	Red	Clay 3056

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

[illegible]

Well Driller

(This form to be executed in triplicate)

WELL RECORD

Date of Receipt .... Permit No. RA-3353

Name of permittee, T. D. Joy

Street or P. O., ... City and State Artesia, N. M.

1. Well location and description: The shallow (shallow or artesian) well is located in NW ¼, NE ¼, NW ¼ of Section 15, Township 17S, Range 26E; Elevation of top of casing above sea level, 3315 feet; diameter of hole, 7"OD inches; total depth, 295 feet; depth to water upon completion, ... feet; drilling was commenced Dec. 14, 19 51 and completed Jan. 8, 19 52 name of drilling contractor D. E. Gray ....; Address, Artesia, New Mex.; Driller's License No. WD.-19

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	260	295	35	Sand & Clay streaks
No. 2				
No. 3				
No. 4				
No. 5				

3. Casing Record:

Diameter in inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforation From	To
8" ~~10" 12"~~					167'8"			
7"OD					257'9"			
5"ID					62'9"		232	to 295

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

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

FILED
DEC 3 1954
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

RA-3353

17.26.15.121

5. Log of Well:

Depth in feet From	Depth in feet To	Thickness in feet	Description of Formation	3345 Gr[illegible]
0	35	35	Clay	3310
35	40	5	Rock & Gravel	3305
40	100	60	Clay & Rock streaks	3245
100	120	20	Sand & Gravel	3225
120	125	5	Clay	3220
125	131	6	Sand	3214
131	134	3	Clay	3211
134	155	21	Sand	3190
155	164	9	Clay	3151
164	200	36	Sand	3145
200	208	8	Clay	3137
208	236	28	Sand	3109
236	237	1	Clay	3108
237	258	21	Sand	3087
258	260	2	Clay	3085
260	295	35	Sand & Clay streaks	3050

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

D N Gray
Licensed Well Driller

Instructions

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

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well D.D. Sullivan ~~Dan~~

Street and Number ____

City ____ State ____

Well was drilled under Permit No. ____ and is located in the

____ ¼ SW ¼ SE ¼ of Section 10 Twp. 17S Rge. 26E

(B) Drilling Contractor Gesler & Slacumb License No. ____

Street and Number ____

City ____ State ____

Drilling was commenced July 27, 19 09

Drilling was completed ____ 19 ____

ORIGINAL FLOW 900 GPM

Elevation at top of casing in feet above sea level [illegible] Total depth of well 1007'

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
8			0	783	783			
4			0	244	244			

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____

Street and Number ____ City ____ State ____

Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____

Plugging method used ____ Date Plugged ____ 19 ____

Plugging approved by:

____
Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received ____

File No. RA-3195, -397 Use ____ Location No. 17.26.10.430

Section 6

LOG OF WELL

Depth in Feet From	To	Thickness in Feet	Color 3340 GL	Type of Material Encountered
0	10		3330	soil
10	22		3318	gyp rock
22	34		3306	sand
34	44		3296	boulders
44	78		3262	rock
78	120		3220	sand
120	302		3038	shale
302	320		3020	gumbo
320	340		3000	clay
340	420			shale
420	480			rock
480	757			shale
757	764			rock
764	789			rock
789	837			rock
837	856			shale
856	865			water rock
865	891			rock
891	956			shale
956	968			rock
968	988			shale
988	1007			rock

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

Well Driller

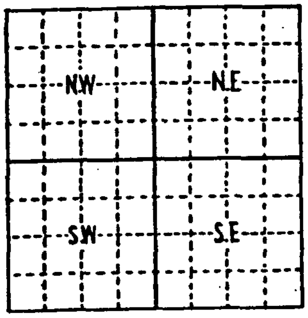
L. B.

WELL RECORD

File No. ____________

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, (P.O. Box 1079) Santa Fe, New Mexico, unless the well is situated in the Roswell Artesian Basin, in which case it should be filed in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

Sec. 1



(Plat of 640 acres)
Locate Well Accurately

Owner of well: G. E. Sharp
Street and Number: East Star Route
Post Office: Artesia, New Mexico
Well was drilled under Permit No. RA2749 and
is located in the NW ¼ NW ¼ NE ¼ of Section 14
Township 17 South, Range 26 East
Drilling Contractor: D. N. Gray
Street and Number: 1007 Mo. St.
Post Office: Artesia, New Mex.

Drilling was commenced July 19 51 Drilling was completed Aug. 18 19 51

Elevation at top of casing in feet above sea level 3310

State whether well is shallow or artesian: Shallow

Total depth of well 241 feet.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from 213 to 241, Thickness in feet 27, Formation Sand
No. 2, from .... to ...., Thickness in feet ...., Formation ....
No. 3, from .... to ...., Thickness in feet ...., Formation ....
No. 4, from .... to ...., Thickness in feet ...., Formation ....
No. 5, from .... to ...., Thickness in feet ...., Formation ....

Sec. 3 RECORD OF CASING

DIAMETER IN INCHES	POUNDS PER FOOT	THREADS PER INCH	NAME OF MANUFACTURER	FEET OF CASING	TYPE OF SHOE	PERFORATED		PURPOSE
						FROM	TO	
8"ID		8		15488"	Collar			Water Shut-off
7"OD				214"	Larkin			Water Shut-off
6"ID				34'	Collar	214	241	

Sec. 4 RECORD OF MUDDING AND CEMENTING

DIAMETER OF HOLE IN INCHES	NUMBER OF SACKS OF CEMENT	METHODS USED	SPECIFIC GRAVITY OF MUD	TONS OF CLAY USED

FILED
AUG 27 1951
OFFICE
ARTESIAN WELL SUPERVISOR
ROSWELL, NEW MEXICO

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the .... ¼ .... ¼ .... ¼ of Section ....,
Range .... Name of plugging contractor ....
Street and Number .... Post Office ....
Tons of clay used .... Tons of roughage used .... Type of roughage ....
.... Was plugging approved by Artesian Well Supervisor ....

Cement plugs were placed as follows:

No. 1 was placed at .... feet Number of sacks of cement used ....
No. 2 was placed at .... feet Number of sacks of cement used ....
No. 3 was placed at .... feet Number of sacks of cement used ....
No. 4 was placed at .... feet Number of sacks of cement used ....
No. 5 was placed at .... feet Number of sacks of cement used ....

(OVER)

RA-3749

17.26.14.211

Sec. 8 LOG OF WELL

FROM (depth in feet)	TO (depth in feet)	THICKNESS IN FEET	CLASSIFICATION OF FORMATION
			3310 GA
0	5	5	Soil 3305
5	18	13	Caleche 3292
18	55	37	Sand 3255
55	70	15	Clay ~~3240~~
70	180	110	Sand 3130
180	184	4	Clay 3126
184	241	57	Sand 3069

I, ... do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ...... Signed D. M. Gray

day of ...., A. D., 19...... Position Contractor

.... Notary Public Street and Number 1007 Mo. St.

My Commission Expires .... Post Office Artesia, N. M.

File No. RA-2649

WELL RECORD

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, P. O. Box 1079, Santa Fe, New Mexico, or in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

(Plat of 640 Acres)
Locate Well Accurately

NW | NE | SW | SE

Owner of well W. L. Webb
Street and Number 1801 Oak Street
Post Office Artesia, New Mexico
Well was drilled under Permit No. RA-2649 and
is located in the SW ¼ SW ¼ SE ¼ of Section 12
Township 17 South Range 26 East
Drilling Contractor Willard Beaty
Street and Number 1102 Merchant St.
Post Office Artesia, New Mexico

Drilling was commenced 7/20, 1950 Drilling was completed 8/5, 1950
Elevation at top of casing in feet above sea level
State whether well is shallow or artesian Shallow
Total depth of well 150 feet. Water level upon completion of well 85 feet below land surface.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from 114 to 130, Thickness in feet 16, Formation Water, Sand & Gravel
No. 2, from to , Thickness in feet , Formation
No. 3, from to , Thickness in feet , Formation
No. 4, from to , Thickness in feet , Formation
No. 5, from to , Thickness in feet , Formation

Sec. 3 RECORD OF CASING

Diameter in Inches	Pounds per Foot	Threads per Inch	Name of Manufacturer	Feet of Casing	Type of Shoe	Perforated From	Perforated To	Purpose
6	12	Welded		150		114	130	

Sec. 4 RECORD OF MUDDING AND CEMENTING

Diameter of Hole in Inches	Number of Sacks of Cement	Methods Used	Specific Gravity of Mud	Tons of Clay Used

AUG 15 1950
OFFICE
ARTESIAN WELL SUPERVISOR
ROSWELL, NEW MEXICO

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ¼ ¼ ¼ of Section , Township
Range Name of plugging contractor
Street and Number Post Office
Tons of clay used Tons of roughage used Type of roughage
Was plugging approved by Artesian Well Supervisor?
Cement plugs were placed as follows:
No. 1 was placed at feet. Number of sacks of cement used
No. 2 was placed at feet. Number of sacks of cement used
No. 3 was placed at feet. Number of sacks of cement used
No. 4 was placed at feet. Number of sacks of cement used
No. 5 was placed at feet. Number of sacks of cement used

(over)

RA-2649

Sec. 6

LOG OF WELL

From (Depth in Feet)	To (Depth in Feet)	Thickness in Feet	Classification of Formation
0	2 3298	2 3300 64	Top Soil
2	20 3280	18	Cleache & Gravel
20	80 3220	60	Red Clay
80	90 3210	10	Sand
90	114 3186	24	Red Clay
114	130 3170	16	Water, Sand & Gravel
130	150 3150	20	Red Clay & Cheache

I, Willard Beaty, do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this 14th day of August, A.D., 1950

Mrs. Johnnie Keith Notary Public

My Commission Expires March 2, 1952

Signed Willard Beaty

Position Drilling Contractor

Street and Number 1102 W. Merchant St.

Post Office Artesia, New Mexico

Form WR-23 STATE ENGINEER OFFICE

FIELD ENGR. LOG

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well ____
Street and Number ____
City ____ State ____
Well was drilled under Permit No. ____ and is located in the ____ ¼ ____ ¼ ____ ¼ of Section ____ Twp. ____ Rge. ____
(B) Drilling Contractor ____ License No. WD-342
Street and Number ____
City ____ State ____
Drilling was commenced ____ 19 ____
Drilling was completed ____ 19 ____

Elevation at top of casing in feet above sea level ____ Total depth of well ____
State whether well is shallow or artesian ____ Depth to water upon completion 130

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

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

____
Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

STATE ENGINEER OFFICE
DISTRICT II
ROSWELL, N. MEX.
1961 JUL 11 AM 8:32

File No. RA-4438 Use Dom. Location No. 17.21.12.244

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered
From	To			
0	10 3290	10	white	Calechie and Gravel
10	78 3222	68	white	White Clay and Gravel
78	90 3210	12	white	Sand and Gravel
90	125 3175	35	white	Clay and Gravel
125	140 3160	15	Brown	Sand and Gravel
140	155 3145	15	Grey	Conglomerate
155	160 3140	5	Brown	Sand and Gravel (water)
160	175 3125	15	Red	Clay

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

Ray Menk.

Well Driller

WATER WELL LOGS USED ON NORTH-SOUTH
CROSS SECTION

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well Howard R. Stroup

Street and Number

City Artesia, State New Mexico

Well was drilled under Permit No. RA-1380 and is located in the NW ¼ SW ¼ SW ¼ of Section 4 Twp. 17 Rge. 26

(B) Drilling Contractor Buck Bros. License No.

Street and Number

City State

Drilling was commenced April 20, 1936

Drilling was completed May 20, 1936

Elevation at top of casing in feet above sea level [illegible] Total depth of well 212

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

Section 2

PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3

RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
12½					196			
10					30			

Section 4

RECORD OF MUDDING AND CEMENTING

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

Section 5

PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-1380 Use Location No. [illegible] 17.26.4.331

LOG OF WELL

[illegible]	[illegible]	[illegible] in Feet	[illegible]	Type of Material Encountered
	[illegible]	[illegible]		Soil
		2242		Gravel - water
[illegible]		[illegible]		Red clay
5	[illegible]	[illegible]		Sand
[illegible]	[illegible]	[illegible]		Rock
[illegible]	[illegible]	[illegible]		Red clay
[illegible]	[illegible]	3147		Red clay
[illegible]	[illegible]	[illegible]		Red sand
24[illegible]		[illegible]		White gyp

[illegible] certifies [illegible] best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Buck Bros.
Well Driller

(This form to be executed in triplicate)

WELL RECORD

Date of Receipt ______________________ Permit No. RA-3262

Name of permittee, ~~J. B. Stephens~~

Street or P. O. Box 121, City and State Artesia, New Mexico

1. Well location and description: The shallow well is located in SE ¼, SE ¼, SE ¼ of Section 5, Township 17S, Range 26E; Elevation of top of casing above sea level, ______ feet; diameter of hole, 8" inches; total depth, 100 feet; depth to water upon completion, 40 feet; drilling was commenced September 12, 1954, and completed September 14, 1954; name of drilling contractor Willard Beaty 1102 Merchant; Address, Artesia, N. M.; Driller's License No. WD-62

(shallow or artesian)

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	70	80	10	sand
No. 2	87	96	9	sand
No. 3				
No. 4				
No. 5				

3. Casing Record:

Diameter in inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforation From	To
6	14	welded	0	100	100	none	70	96

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

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

FILED
OCT 26 1954
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

RA-3262

17.26.5.444

5. Log of Well:

Depth in Feet From	Depth in Feet To	Thickness in feet	Description of Formation
0	1	1	top soil 3354
1	12	11	cleachie 3353
12	22	10	red clay 3343
22	48	26	yellow clay 3317
48	70	22	red clay 3295
70	80	10	water sand 3285
80	87	7	red clay 3278
87	96	9	water sand 3269
96	100	4	clay 3265

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

Willard Beaty
Licensed Well Driller

Instructions

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

(This form to be executed in triplicate)

WELL RECORD

Date of Receipt ______ Permit No. RA-3225

Name of permittee, J. C. Coleman

Street or P. O. Rt. 1, Box 307, City and State Artesia, New Mexico

1. Well location and description: The Shallow (shallow or artesian) well is located in NE ¼, NW ¼, NW ¼ of Section 9, Township 17S, Range 26E; Elevation of top of casing above sea level, ______ feet; diameter of hole, 8 inches; total depth, 100 feet; depth to water upon completion, 25 feet; drilling was commenced May 17, 1954 and completed May 19, 1954; name of drilling contractor Willard Beaty 1102 Merchant; Address, Artesia, New Mexico; Driller's License No. WD 62

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	65	70	5	Sand
No. 2	80	94	14	Sand
No. 3				
No. 4				
No. 5				

3. Casing Record:

Diameter in inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Bottom	Feet of Casing	Type of Shoe	Perforation From	To
6 ID	17	11			100	None	65	94

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

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

FILED
JUN 28 1954
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

RA-3225 17.26.9.112

5. Log of Well:

Depth in Feet From	To	Thickness in feet	Description of Formation	
0	3	3	Top Soil	3357
3	10	7	Cleachie	3350
10	26	16	Red Clay	3334
26	42	16	Yellow Clay	3315
42	50	8	Red Clay	3310
50	65	15	Red Bed	3295
65	70	5	Water Sand	3290
70	80	10	Red Clay	3280
80	94	14	Water Sand	3266
94	100	6	Red Clay	3260

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

Willard Beaty
Licensed Well Driller

Instructions

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

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

	x		

(Plat of 640 acres)

(A) Owner of well Cecil C. Standard

Street and Number Box 232

City Loco Hills State New Mexico

Well was drilled under Permit No. RA 3282 and is located in the NE ¼ [illegible] ¼ [illegible] ¼ of Section 9 Twp. 17S Rge. 26E

(B) Drilling Contractor Willard Beaty License No. [illegible]-62

Street and Number Box 382 1102 Merchant

City Artesia State New Mexico

Drilling was commenced August 28 19 54

Drilling was completed September 2 19 54

Elevation at top of casing in feet above sea level [illegible] Total depth of well 125

State whether well is shallow or artesian Shallow Depth to water upon completion 60

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	89	92	5	Fine Sand
2	105	123	18	Water Sand & Gravel
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7 [illegible]	17	11	0	125	125	collar	105	125

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FILED

FOR USE OF STATE ENGINEER ONLY

AUG 31 1955

OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

Date Received

File No. RA-3282 Use [illegible] Location No. 17.26.9.112

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered	
From	To				
0	2	2	Brown	Top Soil	3358
2	12	10	White	Cleachie	3348
12	50	38	Red	Clay	3310
50	60	10	Brown	Sand, Showing of Water	3300
60	80	20	Red	Clay	3280
80	92	12	Brown	Water Sand	3268
92	105	13	Red	Clay	3255
105	123	18	Brown	Water, Sand & Gravel	3237
123	125	2	Red	Clay	3235

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

Willard Beaty
Well Driller

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well N. E. Garrett

Street and Number

City Las Vegas, State New Mexico

Well was drilled under Permit No. ______ and is located in the

NW ¼ NW ¼ ______ ¼ of Section 9 Twp. 17 Rge. 26

(B) Drilling Contractor G. R. Dublin License No.

Street and Number

City ______ State ______

Drilling was commenced October 10, 19 09

Drilling was completed December 4, 19 09

Original flow: 576 GPM

Elevation at top of casing in feet above sea level [illegible] Total depth of well 1005 ft.

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

Section 2 — PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				1st flow at 880 ft.
2				2nd flow at 940 ft.
3				
4				
5				

Section 3 — RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
6"			0	528				

Section 4 — RECORD OF MUDDING AND CEMENTING

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

Section 5 — PLUGGING RECORD

Name of Plugging Contractor ______ License No. ______

Street and Number ______ City ______ State ______

Tons of Clay used ______ Tons of Roughage used ______ Type of roughage ______

Plugging method used ______ Date Plugged ______ 19 ______

Plugging approved by:

______
Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received ______

File No. (B-35) RA-602 Use ______ Location No. 17.26.9.110 3

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	5			Sandy loam 3355
5	8			Clay 3352
8	15			Gyp rock 3345
15	21			Gyp rock 3339
21	29			Clay 3331
29	43			Clay 3317
43	51			Gumbo 3309
51	59			Sand 3301
59	89			Gumbo 3271
89	91			Gyp rock 3269
91	109			Gumbo 3251
109	120			Sand 3240
120	156			Gumbo 3204
156	241			Gyp rock 3119
241	246			Sand 3114
246	391			Gumbo 2969
391	408			Hard shell rock
408	471			Soft shale
471	498			Sand
498	589			Sand
589	602			Shale
602	648			Sand
648	661			Hard lime stone
661	791			Soft rock
791	810			Shale
810	828			Gray lime rock
828	833			Gray lime rock
833	852			Soft shale rock
852	875			Hard lime rock
875	1005			Hard lime rock

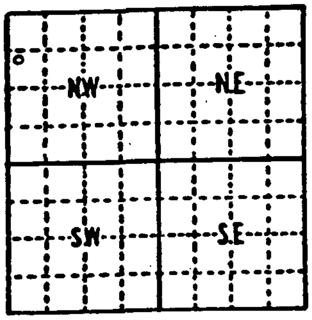
The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

G. R. Dublin
Well Driller

WELL RECORD

File No. RA 2568

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, P. O. Box 1079, Santa Fe, New Mexico, or in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.



(Plat of 640 Acres)
Locate Well Accurately

Owner of well C. C. Armstrong & Son ~~Armstrong and Armstrong~~

Street and Number P. O. Box 873, Roswell, New Mexico

Post Office Roswell, New Mexico

Well was drilled under Permit No. RA- 2568 and

is located in the SW ¼ NW ¼ NE ¼ of Section 16

Township 17S, Range 26E

Drilling Contractor Keyes Drilling Co.

Street and Number 1012 South Penn. Ave.

Post Office Roswell, New Mexico

Drilling was commenced January 21, 1950 Drilling was completed January 26, 1950

Elevation at top of casing in feet above sea level 3350

State whether well is shallow or artesian Shallow

Total depth of well 232 feet. Water level upon completion of well 42 feet below land surface.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from 216 to 220, Thickness in feet 4, Formation Water Sand

No. 2, from ______ to ______, Thickness in feet ______, Formation ______

No. 3, from ______ to ______, Thickness in feet ______, Formation ______

No. 4, from ______ to ______, Thickness in feet ______, Formation ______

No. 5, from ______ to ______, Thickness in feet ______, Formation ______

Sec. 3 RECORD OF CASING

Diameter in Inches	Pounds per Foot	Threads per Inch	Name of Manufacturer	Feet of Casing	Type of Shoe	Perforated From	Perforated To	Purpose
7"	24	8	Used	216'	Texas	None		Surface
5 3/16	18	8	used	30'	none	all		Liner

Sec. 4 RECORD OF MUDDING AND CEMENTING

Diameter of Hole in Inches	Number of Sacks of Cement	Methods Used	Specific Gravity of Mud	Tons of Clay Used

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ______ ¼ ______ ¼ ______ ¼ of Section ______, Township ______,

Range ______ Name of plugging contractor ______

Street and Number ______ Post Office ______

Tons of clay used ______ Tons of roughage used ______ Type of roughage ______

______ Was plugging approved by Artesian Well Supervisor? ______

Cement plugs were placed as follows:

No. 1 was placed at ______ feet. Number of sacks of cement used ______

No. 2 was placed at ______ feet. Number of sacks of cement used ______

No. 3 was placed at ______ feet. Number of sacks of cement used ______

No. 4 was placed at ______ feet. Number of sacks of cement used ______

No. 5 was placed at ______ feet. Number of sacks of cement used ______

(over)

RA 2568

17.26.16.113

Sec. 6 LOG OF WELL

FROM (Depth in Feet)	TO (Depth in Feet)	THICKNESS IN FEET	CLASSIFICATION OF FORMATION
0	4 3276	4	Top Soil
4	18 3262	14	Sandstone
18	40 3340	22	Sandy clay
40	56 3324	16	Sand and clay
56	60 3220	4	Gravel
60	118 3262	58	Sand
118	140 3240	22	Sandy clay
140	148 3232	8	Red clay
148	170 3210	22	Sand and Gravel
170	172 3203	2	Red clay
172	190 3190	18	Conglomerate
190	200 3150	10	Sand and clay
200	216 3168	16	Sandstone
216	220 3160	4	Water sand
220	232 3148	12	Conglomerate

I, Conrad G. Keyes, do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ______ day of ______, A.D., 19___

______ Notary Public

My Commission Expires ______

Signed ______

Position Driller

Street and Number 1012 So. Penn. Ave.

Post Office ______

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well City of Artesia

Street and Number

City ______ State ______

Well was drilled under Permit No. RA-2155 and is located in the SW ¼ SW ¼ NE ¼ of Section 17 Twp. 17 Rge. 26

(B) Drilling Contractor Vernon Wintheiser License No.

Street and Number Box 38

City Hagerman, State New Mexico

Drilling was commenced October 5 19 44

Drilling was completed October 22 19 44

Elevation at top of casing in feet above sea level [illegible] Total depth of well 1071

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	933	939	6	lime
2	943	948	5	lime
3	981	1002	21	lime increase at 995
4	1035	1040	5	lime
5	1040	1055	15	lime increase at 1052
	1055	1068		lime increase at 1068

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
10 3/4	40.5	8			668	Larkin float	none	
13 3/8	48.0	8			174			
					842			

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
		16		100	Halliburton
			Purpose to cement casing		

Section 5 PLUGGING RECORD

Name of Plugging Contractor ______ License No. ______

Street and Number ______ City ______ State ______

Tons of Clay used ______ Tons of Roughage used ______ Type of roughage ______

Plugging method used ______ Date Plugged ______ 19__

Plugging approved by:

______

Basin Supervisor

Cement Plugs were placed as follows:

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

"Hospital well"

FOR USE OF STATE ENGINEER ONLY

Date Received ______

File No. RA-2155 Use ______ Location No. 17.26.17.~~233~~ 41211

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	36	36	3344	soil & caliche
36	50	14	3330	caliche
50	65	15	3315	sand
65	94	34	3296	sand & gyp
94	98	4	3292	hard shell
98	175	85	3205	gyp & sand
175	200	25	3180	sand & gravel
200	205	5	3175	shell
205	234	29	3146	sand & gravel
234	260	26	3120	sand gyp
260	300	40	3050	gyp & red rock
300	323	23	3057	hard ford rock
323	350	27	3030	sandrock
350	400	50	2980	shale & gyp
400	580	180		clay
580	585	5		hard shell
585	609	24		red sand
609	685	76		red rock & shale
685	695	10		hard gyp shell
695	700	5		red shale
700	704	4		lime shell
704	715	11		gyp shell
715	720	5		shale
720	758	38		red sand & rock
792	810	18		hard shale
810	830	20		red sand
830	832	2		hard sand & shale
832	837	5		lime shell
837	862	25		hard gray lime
862	875	13		hard gray lime
875	880	5		water rock (lime)
880	882	2		soft sand
882	885	3		lime
885	895	10		hard gray lime
895	925	30		hard lime
925	933	8		lime
933	939	6		lime (water rock)
939	943	4		lime
943	948	5		increase in water (lime)
948	955	7		lime
955	981	26		lime with shale streaks
981	1002	21		white lime (increase in water)
1002	1010	8		hard white lime
1010	1035	25		white lime
1035	1040	5		lime (water rock)
1040	1055	15		lime (increase in water at 1052)
1055	1068	13		lime (increase in water at 1068)
1068	1071	3		brown lime

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well J. B. Wallace

Street and Number Box 356

City Artesia, State New Mexico

Well was drilled under Permit No. RA-1749 and is located in the Lot 4, ¼ Blk. 4, ¼ Roselawn Addn ¼ SE¼ of Section 17 Twp. 17 Rge. 26

(B) Drilling Contractor Roe L. Newberry License No.

Street and Number

City State

Drilling was commenced April 15, 1940

Drilling was completed April 20, 1940

Elevation at top of casing in feet above sea level Total depth of well 105

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
6					105			

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-1749 Use Location No. 17.26.17.400

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered
From	To			
0	1			Soil
1	17			Sand
17	23			Gravel
23	37			Pink clay
37	53			Gravel
53	105			Water, sand and gravel

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

Roe Newberrry
Well Driller

ADDITIONAL WELL LOGS

Phone 746 2S9

Revised June 1972

FIELD ENGR. ...

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Lee Dilbeck Owner's Well No. RA 6550
Street or Post Office Address 210 Centre
City and State Artesia, New Mexico 88210

Well was drilled under Permit No. RA-6550 and is located in the:

a. SW ¼ NE ¼ ~~NE~~ NW ¼ ¼ of Section 10 Township 17S Range 26E N.M.P.M.

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

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

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

(B) Drilling Contractor H & W Enterprises License No. WD675

Address P.O. Box 437 Artesia NM 88210 E. of Artesia 746-4516

Drilling Began 8-1-79 Completed 8-10-79 Type tools Cable Size of hole 7" in.

Elevation of land surface or ______ at well is 3355 ft. Total depth of well 125 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 50 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
95	120	25	Water Sand	10

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
7"	29 Lb	P/E	1	125	126	P/E	90	120

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

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

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received 8/16/79

Quad ______ FWL ______ FSL ______

File No. RA-6550 Use D-S Location No. 17.26.10.12323

170 From E Line
120 S From N Line

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	20	20	Top Soil
20	60	40	Calicher- Clay
60	85	25	Fine Brown Sand
85	95	10	Coarse Sand
95	120	25	Water & Sand
120	125	5	Red Bed TD

Section 7. REMARKS AND ADDITIONAL INFORMATION

STATE ENGINEER OFFICE

'79 AUG 16 AM 8 15

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

Tony Hall

Driller

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

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well H. G. Southworth

Street and Number

City Artesia State New Mexico

Well was drilled under Permit No. RA-768 and is located in the SW ¼ NE ¼ SW ¼ of Section 9 Twp. 17 Rge. 26

(B) Drilling Contractor Myron Bruning License No.

Street and Number Box 881

City Artesia State New Mexico

Drilling was commenced September 20 19 43

Drilling was completed November 5 19 43

Elevation at top of casing in feet above sea level Total depth of well 1214

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
13" O.D.	50	8			80	)	set in one string joined	
10 3/4 O.D	40	8			795	Drive)	with sledge nipple.	
						)	total length 875	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
		13 3/4	540		pumped in by plug

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-768 Use Location No. 17.26.9.323

Section 6

LOG OF WELL

Depth in Feet		Thickness in Feet	Color	Type of Material Encountered
From	To			
0	5	3360		soil
5	30	3335		sandy gyp & clay
30	80	3285		sand & gyp
80	290	3075		gyp & sandy clay
290	385	2980		gyp & sandy clay
385	720			red sand & gyp stratas
720	755			rock
775	870			red bed & rock stratas
870	875			lime rock
	casing	set		
875	880			water rock
880	1214			limerock several streaks of water rock
total depth of well is 1214 feet.				

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

--S-- Myron Bruning
Well Driller

L. B.

WELL RECORD

FILE No. RA-1440

INSTRUCTIONS: This form should be typewrttten, and filed in the office of the State Engineer, (P.O. Box 1079) Santa Fe, New Mexico, unless the well is situated in the Roswell Artesian Basin, in which case it should be filed in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

SEC. 1

NW	NE
SW	SE

(Plat of 640 acres)
Locate Well Accurately

Owner of well W. J. Jackson

Street and Number

Post Office Artesia, New Mexico

Well was drilled under Permit No. RA-1440 and

is located in the SW ¼ NW ¼ NE ¼ of Section 9

Township 17S/ , Range 26E.

Drilling Contractor Roe L. Newberry and W. P. Black

Street and Number

Post Office

Drilling was commenced February 10 1941 Drilling was completed February 26th 1941

Elevation at top of casing in feet above sea level 3350

State whether well is shallow or artesian Shallow 320'

SEC. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from ______ to ______, Thickness in feet ______, Formation ______

No. 2, from ______ to ______, Thickness in feet ______, Formation ______

No. 3, from ______ to ______, Thickness in feet ______, Formation ______

No. 4, from ______ to ______, Thickness in feet ______, Formation ______

No. 5, from ______ to ______, Thickness in feet ______, Formation ______

SEC. 3 RECORD OF CASING

DIAMETER IN INCHES	POUNDS PER FOOT	THREADS PER INCH	NAME OF MANUFACTURER	FEET OF CASING	TYPE OF SHOE	PERFORATED FROM	PERFORATED TO	PURPOSE
12½				202				
10				106				
	Pipe slit with torch ,6 slits per circle.							

SEC. 4 RECORD OF MUDDING AND CEMENTING

DIAMETER OF HOLE IN INCHES	NUMBER OF SACKS OF CEMENT	METHODS USED	SPECIFIC GRAVITY OF MUD	TONS OF CLAY USED

SEC. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ______ ¼ ______ ¼ ______ ¼ of Section ______ Township ______

Range ______ Name of plugging contractor ______

Street and Number ______ Post Office ______

Tons of clay used ______ Tons of roughage used ______ Type of roughage ______

______ Was plugging approved by Artesian Well Supervisor ______

Cement plugs were placed as follows:

No. 1 was placed at ______ feet ______ Number of sacks of cement used ______

No. 2 was placed at ______ feet ______ Number of sacks of cement used ______

No. 3 was placed at ______ feet ______ Number of sacks of cement used ______

No. 4 was placed at ______ feet ______ Number of sacks of cement used ______

No. 5 was placed at ______ feet ______ Number of sacks of cement used ______

(OVER)

RA-1440 17.26.9.213

SEC. 6 ... LOG OF W...

FROM (DEPTH IN FEET)	TO (DEPTH IN FEET)	THICKNESS IN FEET	CLASS OF FORMATION
35	60	25	Yellow Sandy Clay
80	110	30	Pink Clay
110	130	20	Red Sand - Water
130	150	20	Red Sandy Clay
150	170	20	Yellow, sandy clay
170	196	26	Red sand clay, some gravel
196	210	14	Pink Water Sand
210	225	15	White water Sand
225	245	20	Red Sandy Clay
245	260	15	Water Sand
260	285	25	Red Clay
285	320	35	Water Sand, bottomed at red clay.

I, ______________________ do s... swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for wh... report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ______

day of ______________________, A. D., 19 ____

______________ Notary Public

My Commission Expires ______

Signed G. J. Jackson

Position ______

Street and Number ______

Post Office ______

L.B.

WELL RECORD

File No.

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, P. O. Box 1079, Santa Fe, New Mexico, or in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

NW	NE
SW	SE

(Plat of 640 Acres)
Locate Well Accurately

Owner of well Britton Coll

Street and Number Route 1 Box 30

Post Office Artesia, New Mexico

Well was drilled under Permit No. RA 2698 and

is located in the SE ¼ SE ¼ NE ¼ of Section 9

Township 17 S, Range 26 E.

Drilling Contractor Blount & Coll

Street and Number Route 1 Box 30

Post Office Artesia, New Mexico

Drilling was commenced July 28, 1951 Drilling was completed July 31 1951

Elevation at top of casing in feet above sea level 3342

State whether well is shallow or artesian Shallow, Stock well

Total depth of well 140 feet. Water level upon completion of well 10 feet below land surface.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from 18 to 30, Thickness in feet 12, Formation Gyp

No. 2, from 50 to 80, Thickness in feet 30, Formation Clay & Gravel

No. 3, from 130 to 140, Thickness in feet 10, Formation Gravel

No. 4, from to, Thickness in feet, Formation

No. 5, from to, Thickness in feet, Formation

Sec. 3 RECORD OF CASING

Diameter in Inches	Pounds per Foot	Threads per Inch	Name of Manufacturer	Feet of Casing	Type of Shoe	Perforated From	Perforated To	Purpose
8				40				Shut off surface water.
7				23				Meet domestic well requirements.

Sec. 4 RECORD OF MUDDING AND CEMENTING

Diameter of Hole in Inches	Number of Sacks of Cement	Methods Used	Specific Gravity of Mud	Tons of Clay Used

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ¼ ¼ ¼ of Section, Township

Range Name of plugging contractor

Street and Number Post Office

Tons of clay used Tons of roughage used Type of roughage

Was plugging approved by Artesian Well Supervisor?

Cement plugs were placed as follows:

No. 1 was placed at feet. Number of sacks of cement used

No. 2 was placed at feet. Number of sacks of cement used

No. 3 was placed at feet. Number of sacks of cement used

No. 4 was placed at feet. Number of sacks of cement used

No. 5 was placed at feet. Number of sacks of cement used

FILED
DEC 12 1951
OFFICE
ARTESIAN WELL SUPERVISOR
ROSWELL, NEW MEXICO

(over)

RA-2698

17.26.9.244

Sec. 6

LOG OF WELL

FROM (Depth in Feet)	TO (Depth in Feet)	THICKNESS IN FEET	CLASSIFICATION OF FORMATION
0	18	18	Topsoil & Clay
18	30	12	Gyp
30	50	20	Clay
50	80	30	Gravel & Clay
80	130	50	Sand rock
130	140	10	Sand & Gravel

I, ______________________, do solemnly swear that, to the best of my knowledge and *belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can* be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ________ day of ____________, A.D., 19____

____________________ Notary Public

My Commission Expires ____________

Signed ____________

Position ____________

Street and Number ____________

Post Office ____________

Form WR-23

FIELD ENGR. LOG

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well R. J. Heard

Street and Number Box 416

City Loco Hills State N.M.

Well was drilled under Permit No. RA-4922 and is located in the NW ¼ NW ¼ ____ ¼ of Section 10, Twp. 17S Rge. 26E

(B) Drilling Contractor A. F. Smith License No. WD 28

Street and Number Box 1222

City Artesia State N.M.

Drilling was commenced Dec. 1963

Drilling was completed Dec. 1963

Elevation at top of casing in feet above sea level 3320 Total depth of well 218'

State whether well is shallow or artesian domestic Depth to water upon completion 25'

Section 2

PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	25	35	10	sand
2	96	139	43	sand
3				
4				
5				

Section 3

RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7"					139	None	118	139

Section 4

RECORD OF MUDDING AND CEMENTING

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

Section 5

PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____

Street and Number ____ City ____ State ____

Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____

Plugging method used ____ Date Plugged ____ 19__

Plugging approved by:

____
Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received STATE ENGINEER OFFICE DISTRICT II 1963 DEC 24 AM 8:26 ✓

File No. RA 4922 Use Dom. Location No. 17.26.10.110

Dom-ok

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	25	25		red Clay
25	35	10		Sand
35	96	61		red Clay
96	139	43		sand
139	218	79		red Clay

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

A. F. Smith
Well Driller

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well V. L. Gates

Street and Number

City Artesia, State New Mexico

Well was drilled under Permit No. RA-307 and is located in the SW ¼ SW ¼ ¼ of Section 10 Twp. 17S Rge. 26E

(B) Drilling Contractor Pearson Bros. License No.

Street and Number

City Lake Arthur State

Drilling was commenced 5-15-26 19

Drilling was completed 6-28-26 19

Elevation at top of casing in feet above sea level [illegible] Total depth of well 1263

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

Section 2 — PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				
2				
3				
4				
5				

Section 3 — RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
12½					452			
10					930			
10 inch comes up about 15 feet in 12½ inch casing no seal.								

Section 4 — RECORD OF MUDDING AND CEMENTING

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

Section 5 — PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-307 Use Location No. 17.26.10.330

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	20			soil and gyp
20	45			gravel
45	56			clay
55	60			rock
60	75			white gumbo
75	94			white gumbo
94	118			white gumbo
118	139			white gumbo
139	159			gumbo
159	177			gumbo
177	197			sand
197	217			sand rock
217	239			sand
239	276			sand
276	295			sand shale
295	314			sandy shale
314	334			sand
334	353			rock
353	373			rock
373	393			gumbo and rock caving
393	411			gumbo
411	432			sand
432	452			rock and sand
452	471			rock and sand
471	491			red clay
491	512			sand
512	531			sand
531	552			gumbo
552	572			gumbo
572	586			clay and typ rock
586	645			sand
645	664			clay
664	685			clay
685	705			sand
705	720			sand
720	740			sand rock
740	759			sand rock
759	779			sand rock
779	799			rock
799	818			sand rock
818	837			hard rock
837	852			rock and clay
852	871			rock
871	891			rock and sand
891	908			clay and sand
908	928			hard rock
928	947			hard rock
947	969			sand 4 or rock 17
969	990			hard rock
990	1010			hard rock
1010	1067			hard rock
1067	1086			rough rock
1086	1106			first flow
1106	1124			rock
1124	1143			limerock
1143	1160			limerock
1160	1184			limerock
1184	1202			limerock rough streaks
1202	1222			limerock rough streaks
1222	1242			limerock rough streaks
1242	1263			limerock rough streaks

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

Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

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

Section 1

(Plat of 640 acres)

(A) Owner of well D. D. Sullivan

Street and Number

City Artesia, State New Mexico

Well was drilled under Permit No. RA-1300 and is located in the SW ¼ SE ¼ ¼ of Section 10 Twp. 17 Rge. 26

(B) Drilling Contractor R & R Drilling Co. License No.

Street and Number

City State

Drilling was commenced March 24, 19 37

Drilling was completed April 2, 19 37

Elevation at top of casing in feet above sea level Total depth of well 210 ft.

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

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1		18'	1st flow	
2		36 to 40	2nd flow	
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To

Section 4 RECORD OF MUDDING AND CEMENTING

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

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

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

FOR USE OF STATE ENGINEER ONLY

Date Received

File No. RA-1300 Use Location No. 17.26.10.430

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color 3240 GL	Type of Material Encountered
0	23		3217	Gypsum rock
23	25		3215	Water sand
25	36		3204	Sand and gravel
36	40		3200	Gravel (water)
40	43		3297	Water sand
43	48		3292	White clay
48	55		3285	White clay
55	70		3270	Water sand
70	76		3264	White clay
76	80		3260	Sand
80	90		3250	White clay
90	125		3215	White clay
125	132		3208	Sand rock
132	145		3195	White clay
145	150		3190	Sand
150	157		3183	Sand rock
157	175		3165	Water sand
175	195		3145	White clay
195	206		3134	Sand rock
206	210		3130	Water sand

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

R & R Drilling Co.
Well Driller

APPENDIX B
WATER QUALITY ANALYSES

WATER QUALITY OF MONITOR WELLS
NEAR EVAPORATION PONDS

ASSAIGAI
ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

CUSTOMER Navajo Refining Co ny
ADDRESS Box 526
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

Kinney

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. #20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80
Navajo Well #1	Acidity		179	
	Alkalinity, "P" (As $CaCO_3$)	<	1	
	Barium		0.1	
	Biochemical Oxygen Demand		44	
	Cadmium		0.05	
	Chemical Oxygen Demand		145	
	Chloride		8313	5800
	Chromium		0.002	
	Chromium 6+	<	0.01	
	Copper		0.001	
	Fluoride		0.9	0.8
	Hardness (as $CaCO_3$)		5760	
	Iron		0.05	
	Lead		0.006	
	Magnesium		850	
	Nickel		0.02	
	pH Units		7.8	
	Phenols		0.015	
	Alkalinity , "M"		700	
	Solids, Total Dissolved		19700	15800
	Sulfate		4920	
	Sulfide		0.21	
	Zinc	<	0.1	

C1/80

169

Sample Analysis by: B.P.
Date and Time of Analysis: BOD_5 - 4/24/81 @ 1600 hrs.
pH: 4/30/81 @ 1400 hrs.
Method of Analysis: BOD_5 - 5 day incubation
pH: electrode

4/30/81

APPROVED BY
Elmer D. Martinez, Director of Quality

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible]ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	4/3?
Navajo Well # 3	Acidity		32		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium	<	0.1		
	Biochemical Oxygen Demand		40		
	Cadmium		0.009		
	Chemical Oxygen Demand		73		
	Chloride		2652	2200	118[illegible]
	Chromium	<	0.001		
	Chromium 6+	<	0.01		
	Copper	<	0.001		
	Fluoride		1.6	5.0	3.2
98	Hardness (as $CaCO_3$)		2760		
	Iron		0.01		
	Lead	<	0.001		
	Magnesium		250		
	Nickel	<	0.01		
	pH Units		7.4		
	Phenols	<	0.001		
	Alkalinity, "M"		356		
	Solids, Total Dissolved		7730	7640	677[illegible]
	Sulfate		2720		
	Sulfide		0.10		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]

Elmer D. Martinez, Director of Quality Assurance

4/30/81

CEC
Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Cor[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/3/?
Navajo Well # 5	Acidity		36		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium		0.1		
	Biochemical Oxygen Demand		24		
	Cadmium		0.05		
	Chemical Oxygen Demand		176		
	Chloride		7089	8600	4[illegible]
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.001		
	Fluoride		0.44	0.96	0.43
	Hardness (as $CaCO_3$)		4660		
	Iron		0.04		
	Lead		0.007		
	Magnesium		650		
	Nickel	<	0.01		
	pH Units		7.7		
	Phenols	<	0.001		
	Alkalinity, "M"		506		
	Solids, Total Dissolved		16,800	21,100	7367
	Sulfate		4290		
	Sulfide		0.13		
	Zinc	<	0.1		

165

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]
Elmer D. Martinez, Director of Quality Assurance
4/30/81

CEC
Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502
Telephone 505/982-9841

CUSTOMER Navajo Refining Co. ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/?
Navajo Well # 7	Acidity		36		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium	<	0.1		
	Biochemical Oxygen Demand		38		
	Cadmium		0.04		
	Chemical Oxygen Demand		136		
	Chloride		3570	3400	80?
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.004		
	Fluoride		0.3	0.92	0.9?
,64	Hardness (as $CaCO_3$)		3160		
	Iron		0.05		
	Lead		0.001		
	Magnesium		370		
	Nickel	<	0.01		
	pH Units		8.0		
	Phenols	<	0.001		
	Alkalinity, "M"		596		
	Solids, Total Dissolved		14,200	21,500	28,0?
	Sulfate		5600		
	Sulfide		0.05		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]
Elmer D. Martinez, Director of Quality Assurance
4/30/81

CEP
Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80
Navajo Well # 9	Acidity		36	
	Alkalinity, "P" (as $CaCO_3$)	<	1.0	
	Barium	<	0.1	
	Biochemical Oxygen Demand		36	
	Cadmium		0.01	
	Chemical Oxygen Demand		88	
	Chloride		2703	2200
	Chromium		0.002	
	Chromium 6+	<	0.01	
	Copper		0.006	
	Fluoride		0.7	1.8
.65	Hardness (as $CaCO_3$)		3120	
	Iron		0.01	
	Lead		0.001	
	Magnesium		370	
	Nickel	<	0.01	
	pH Units		7.7	
	Phenols	<	0.001	
	Alkalinity, "M"		322	
	Solids, Total Dissolved		10,400	9820
	Sulfate		4160	
	Sulfide		0.03	
	Zinc	<	0.1	

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/3/
Navajo Well # 12	Acidity		55		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium	<	0.1		
	Biochemical Oxygen Demand		38		
	Cadmium		0.07		
	Chemical Oxygen Demand		256		
	Chloride		8058	6700	7300
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.002		
	Fluoride		0.9	2.5	1.49
.10	Hardness (as $CaCO_3$)		8920		
	Iron		0.04		
	Lead		0.007		
	Magnesium		1330		
	Nickel		0.02		
	pH Units		7.6		
	Phenols		*< 0.001		
	Alkalinity, "M"		545		
	Solids, Total Dissolved		28,900	29,000	2284
	Sulfate		11,500		
	Sulfide		0.05		
	Zinc	<	0.1		

* Data will follow on 5/6/81.

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]
Elmer D. Martinez, Director of Quality Assurance
4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter	11/21/80	10/?/77
Navajo Well # 13	Acidity		11		
	Alkalinity, "P" (as $CaCO_3$)	<	1.0		
	Barium		0.1		
	Biochemical Oxygen Demand		22		
	Cadmium		0.002		
	Chemical Oxygen Demand		48		
	Chloride		357	380	123
	Chromium		0.002		
	Chromium 6+	<	0.01		
	Copper		0.001		
	Fluoride		1.2	3.5	1.47
	Hardness (as $CaCO_3$)		1570		
.20	Iron		0.02		
	Lead		0.003		
	Magnesium		79		
	Nickel	<	0.01		
	pH Units		7.4		
	Phenols	<	0.001		
	Alkalinity, "M"		146		
	Solids, Total Dissolved		3200	3060	2531
	Sulfate		1810		
	Sulfide		0.04		
	Zinc	<	0.1		

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Well # 16	Acidity		13
	Alkalinity, "P" (as $CaCO_3$)	<	1.0
	Barium	<	0.1
	Biochemical Oxygen Demand		44
	Cadmium		0.002
	Chemical Oxygen Demand		152
	Chloride		1173
	Chromium	<	0.001
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		0.44
.62	Hardness (as $CaCO_3$)		1610
	Iron	<	0.01
	Lead		0.002
	Magnesium		140
	Nickel	<	0.01
	pH Units		7.7
	Phenols		0.016
	Alkalinity, "M"		425
	Solids, Total Dissolved		4,770
	Sulfate		1,890
	Sulfide		0.10
	Zinc		0.1

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

REPORT OF ANALYSIS

CUSTOMER Navajo Refining Cor[illegible]y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Well # 17	Acidity		17
	Alkalinity, "P" (as $CaCO_3$)	<	1.0
	Barium		0.1
	Biochemical Oxygen Demand		42
	Cadmium		0.03
	Chemical Oxygen Demand		88
	Chloride		4692
	Chromium		0.002
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		0.3
	Hardness (as $CaCO_3$)		4470
	Iron		0.03
	Lead		0.005
	Magnesium		470
	Nickel		0.01
	pH Units		7.6
	Phenols	<	0.001
	Alkalinity, "M"		198
	Solids, Total Dissolved		11,200
	Sulfate		2,930
	Sulfide		0.03
	Zinc		0.1

16

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]

Elmer D. Martinez, Director of Quality Assurance

4/30/81

CEC
Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

REPORT TO Navajo Refining Company
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

RECEIVED
MAY 6 1981

REPORT OF ANALYSIS

~~NAVAJO REFINING CO.~~

SAMPLES RECEIVED 4/24/81 CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water Windmill (Fig 4-9 Revised)

Sample Identification	Type of Analysis		mg/liter
Well Water	Acidity		13
Log?	Alkalinity, "P" (as $CaCO_3$)	<	1
Which?	Barium	<	0.1
	Biochemical Oxygen Demand		38
	Cadmium		0.002
	Chemical Oxygen Demand		88
	Chloride		1632
	Chromium		0.002
	Chromium 6+	<	0.01
	Copper		0.004
	Fluoride		0.25
	Hardness (as $CaCO_3$)		2400
	Iron		0.06
	Lead		0.005
	Magnesium		310
	Nickel	<	0.01
	pH Units		7.8
	Phenols		0.022
	Alkalinity, "M"		205
	Solids, Total Dissolved		6860
	Sulfate		2830
	Sulfide		0.03
	Zinc		0.2

10/3/7

11130

0.32

6162

0.55

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Co. .any
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO. 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. #20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis	mg/liter
Navajo Well #12	Phenols	< 0.001

4/30/81

APPROVED BY Elmer D. Martinez, Director of Quality Assurance

PAGE 1 OF 1 PAGE

Controls for Environmental Pollution, Inc.

P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

WATER QUALITY OF MONITOR WELLS
IN REFINERY AREA

ASSAIGAI
ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

ASSAIGAI
ANALYTICAL LABORATORIES, INC.

TO: Geo Science
Attn: Randy Hicks
500 Copper N.W.
Albuquerque, NM 87105

DATE: 3 December 1984
1111

ANALYTE	Fire Pond 10/31/83 1550	Well 47 10/31/84 1520	Well 28 11/1/84 1330
Phenols	20.0 ug/1	33.0 ug/1	20.0 ug/1
Cl	134.0 mg/1	122.0 mg/1	101.0 mg/1
SO	1800.0 mg/1	1400.0 mg/1	2150.0 mg/1
TDS	3664.0 mg/1	2728.0 mg/1	5192.0 mg/1
TSS	96.0 mg/1	13588.0 mg/1	720.0 mg/1
NO	2.18 mg/1	1.79 mg/1	1.63 mg/1
NH	1.0 mg/1	0.3 mg/1	0.3 mg/1
Cr	<0.01 mg/1	<0.01 mg/1	<0.01 mg/1
CN	<0.01 mg/1	<0.01 mg/1	<0.01 mg/1

SAMPLE IDENTIFICATION/ANALYTICAL RESULTS

ANALYTE	Well 45 10/31/84 1432	Well 46 10/31/84 1240	NOMINAL DETECTION LIMIT
Phenols	16.0 ug/1	13.0 ug/1	0.01 ug/1
Cl	495.0 mg/1	446.0 mg/1	1.0 mg/1
SO	1650.0 mg/1	2100.0 mg/1	1.0 mg/1
TDS	3836.0 mg/1	3988.0 mg/1	1.0 mg/1
TSS	2004.0 mg/1	4084.0 mg/1	1.0 mg/1
NO	0.10 mg/1	0.80 mg/1	0.1 mg/1
NH	11.6 mg/1	1.0 mg/1	0.1 mg/1
Cr	<0.01 mg/1	<0.01 mg/1	0.01 mg/1
CN	<0.01 mg/1	<0.01 mg/1	0.01 mg/1

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y., 1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

7300 Jefferson, N.E. Albuquerque, New Mexico 87109

		Upgradient Well 35	Downgradient Wells 36	37	38
pH		7.28	7.27	7.57	7.37
Spec Cond		3942	9462	9462	7899
TOC	(*)				
TOX Ug/l		318	125	223	170
Chloride	(*)				
Iron		4.6	0.89	0.14	0.73
Manganese		1.34	1.34	1.26	0.789
Phenols		0.001	0.001	0.001	0.001
Sodium	(*)				
Sulfate	(*)				
Arsenic		0.07	0.03	0.02	0.02
Barium		0.1	0.1	0.1	0.1
Cadmium		0.001	0.001	0.001	0.001
Chromium		0.003	0.002	0.001	0.001
Fluoride		1.45	1.34	2.05	1.60
Lead		0.001	0.001	0.001	0.001
Mercury		0.0004	0.0004	0.0004	0.0004
Nitrate		0.1	0.1	0.1	0.1
Selenium		0.01	0.01	0.01	0.01
Silver		0.01	0.01	0.01	0.01
Pest & Herb		-	-	-	-
Radio	(**)	-	-	-	-
Coliform		1	1	2700	1

* Results pending, re-analysis by laboratory.
** Radioactivity activity results were omitted due to high TDS.

Table 5. Chemical data from TEL Weathering area monitoring wells taken 12-1-82.

Geraghty & Miller, Inc.

		Upgradient Well	Downgradient Wells		
		31	32	33	34
pH		7.31	7.41	7.41	7.30
Spec Cond.		~~25544.5~~ 2489	2693	3590	2563
TOC mg/l	(*)				
TOX ug/l		41.5	102.3	64.5	26
Chloride	(*)				
Iron		0.06	0.01	0.01	1.81
Manganese		1.08	0.311	0.521	0.567
Phenols		0.001	0.001	0.001	0.001
Sodiu		100	35.4	44.4	88.5
Sulfate	(*)				
Arsenic		0.01	0.01	0.01	0.01
Barium		0.1	0.1	0.1	0.1
Cadmium		0.001	0.001	0.001	0.001
Chromium		0.001	0.001	0.001	0.004
Fluoride		1.15	1.28	2.70	1.28
Lead		0.002	0.001	0.001	0.005
Mercury		0.0004	0.0004	0.0004	0.0004
Nitrate		0.1	0.1	0.1	0.1
Selenium		0.01	0.01	0.01	0.01
Silver		0.01	0.01	0.01	0.01
Pest & Herb		ND	ND	ND	ND
Radio	(**)	-	-	-	-
Coliform	(*)				

* Results pending, re-analysis by laboratory.
** Radioactivity results were omitted due to high TDS.

Table 4. Chemical data from the Colony Landfarm monitoring wells taken 12-2-82.

QUALITY OF WATER IN EVAPORATION PONDS

ASSAIGAI

ANALYTICAL LABORATORIES, INC.

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS		
	11184 1330 Well 28	103184 1432 Well 45	103184 1240 Well 46
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	103184 1520 Well 47	103184 1550 Fire Pond	
Benzene	<0.005 mg/l	<0.005 mg/l	
Toluene	<0.005 mg/l	<0.005 mg/l	
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	
Xylenes	<0.005 mg/l	<0.005 mg/l	
	Well 3	Well 5	Well 12
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	1.16 mg/l	2.5 mg/l	0.25 mg/l
CN	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
Benzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Toluene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Xylenes	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
Ethylbenzene	<0.005 mg/l	<0.005 mg/l	<0.005 mg/l
	Well 13	Pond 1	Pond 3
NO_3 as N	<0.01 mg/l	<0.01 mg/l	<0.01 mg/l
NH_4	5.6 mg/l	10.6 mg/l	13.87 mg/l
CN	0.09 mg/l	0.4 mg/l	0.2 mg/l
Benzene	0.254 mg/l	0.711 mg/l	0.027 mg/l
Toluene	0.345 mg/l	0.588 mg/l	<0.005 mg/l
Xylenes	0.389 mg/l	0.591 mg/l	<0.005 mg/l
Ethylbenzene	<0.100 mg/l	0.240 mg/l	<0.005 mg/l

TO: Geo Science
500 Copper Ave. N.W.
Albuquerque, NM

DATE: 8 November 1984
1080, 1040

ANALYTE	SAMPLE ID/ANALYTICAL RESULTS	
	Pond #1 floating film	NOMINAL DETECTION LIMIT
NO_3 as N		0.01 mg/l
NH_4		0.1 mg/l
CN		0.01 mg/l
Benzene	0.617 mg/l	0.005 mg/l
Toluene	0.467 mg/l	0.005 mg/l
Xylenes	0.463 mg/l	0.005 mg/l
Ethylbenzene	0.201 mg/l	0.005 mg/l

REFERENCE: "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, N.Y. ,1980.

An invoice for services is enclosed. Thank you for contacting Assaigai Laboratories.

Sincerely,

Jennifer V. Smith

Jennifer V. Smith, Ph.D.
Laboratory Director

CUSTOMER Navajo Refining Co. ny
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030
TYPE OF ANALYSIS Water	

Sample Identification	Type of Analysis		mg/liter
Navajo West Pond	Acidity		13
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium		0.2
	Biochemical Oxygen Demand		116
	Cadmium		0.003
	Chemical Oxygen Demand		102
	Chloride		918
	Chromium		0.04
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		6.6
	Hardness (as $CaCO_3$)		760
	Iron		0.06
	Lead		0.002
	Magnesium		60
	Nickel		0.01
	pH Units		7.7
	Phenols		0.04
	Alkalinity, "M"		173
	Solids, Total Dissolved		2930
	Sulfate		885
	Sulfide		25.1
	Zinc	<	0.1

10d

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER	Navajo Refining Con y
ADDRESS	Drawer 159
CITY	Artesia, NM 88210
ATTENTION	Ed Kinney
INVOICE NO	104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81	CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo Middle Pond	Acidity		29
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		116
	Cadmium		0.002
	Chemical Oxygen Demand		363
	Chloride		1468
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper	<	0.001
	Fluoride		7.4
	Hardness (as $CaCO_3$)		1060
	Iron		0.06
	Lead	<	0.001
	Magnesium		96
	Nickel	<	0.01
	pH Units		7.4
	Phenols		0.027
	Alkalinity, "M"		349
	Solids, Total Dissolved		4020
	Sulfate		1050
	Sulfide		13.4
	Zinc	<	0.1

140

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY

Elmer D. Martinez, Director of Quality Assurance

4/30/81

Controls for Environmental Pollution, Inc.

P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502

CUSTOMER Navajo Refining Con y
ADDRESS Drawer 159
CITY Artesia, NM 88210
ATTENTION Ed Kinney
INVOICE NO 104223

REPORT OF ANALYSIS

SAMPLES RECEIVED 4/24/81 | CUSTOMER ORDER NUMBER P.O. # 20030

TYPE OF ANALYSIS Water

Sample Identification	Type of Analysis		mg/liter
Navajo East Pond	Acidity		10
	Alkalinity, "P" (as $CaCO_3$)	<	1
	Barium	<	0.1
	Biochemical Oxygen Demand		72
	Cadmium		0.002
	Chemical Oxygen Demand		225
	Chloride		1632
	Chromium		0.1
	Chromium 6+	<	0.01
	Copper		0.002
	Fluoride		5.8
	Hardness (as $CaCO_3$)		1160
	Iron		0.1
	Lead	<	0.001
	Magnesium		110
	Nickel	<	0.01
	pH Units		7.2
	Phenols	<	0.001
	Alkalinity, "M"		214
	Solids, Total Dissolved		4920
	Sulfate		1520
	Sulfide		0.36
	Zinc	<	0.1

10d

Sample Analysis by: BP

Date and Time of Analysis: BOD_5: 4/24/81 @ 1600 hrs.

pH: 4/30/81 @ 1400 hrs.

Method of Analysis: BOD_5 - 5 day incubation

pH:electrode

APPROVED BY [signature]

Elmer D. Martinez, Director of Quality Assurance

4/30/81 PAGE 2 OF 13 PAGE

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Controls for Environmental Pollution, Inc.
P.O. Box 5351 • 1925 Rosina • Santa Fe, New Mexico 87502