PNM PUBLIC SERVICE COMPANY OF NEW MEXICO
ALVARADO SQUARE ALBUQUERQUE, NEW MEXICO 87158

December 29, 1983

Mr. Anthony Drypolcher
Acting Bureau Chief
Groundwater and Hazardous
Waste Bureau
New Mexico Environmental
Improvement Division
Post Office Box 968
Santa Fe, NM 87504-0968

Dear Mr. Drypolcher:

Subject: Public Service Company of New Mexico - Person Generating Station - EPA ID #NMT360010342

Enclosed is information Public Service Company of New Mexico (PNM) agreed to provide in our meeting with New Mexico Environmental Improvement Division (NMEID) December 12, 1983. The attachments are as follows:

Attachment 1: Minutes of December 12, 1983, Meeting of PNM and NMEID

Attachment 2: Summary of Phase I Investigation at Public Service Company of New Mexico - Person Generating Station

Attachment 3: Geologic Description of Person Well - Field Area

Attachment 4: Description of Person Station Production Wells

Attachment 5: Waste Oil Recycling at PNM Generating Facilities

PNM would like to meet with you and members of your staff to discuss the enclosed material after its review. If this is agreeable, please contact me at 848-2029.

Very truly yours,

Richard A. Jordan, Manager
Regulatory Licensing and Compliance

RAJ:wp
Attachments

xc: Mr. Jack Rex

ATTACHMENT 1

Minutes of Meeting Between
New Mexico Environmental Improvement Division and
Public Service Company of New Mexico
December 12, 1983

Subject: Public Service Company of New Mexico
Person Generating Station
EPA ID #NMT360010342

Public Service Company of New Mexico (PNM) and New Mexico Environmental Improvement Division (NMEID) met at NMEID's office December 12, 1983. In attendance were:

PNM

Richard Jordan, Regulatory Licensing and Compliance
Tony Hurst, Generation Engineering
Bill Glover, Regulatory Licensing and Compliance
Randy Ransdell, Power Production
Jody Plum, Regulatory Licensing and Compliance

NMEID

Jack Elvinger, Hazardous Waste Section
Raymond Sisneros, Hazardous Waste Section
Boyd Hamilton, Hazardous Waste Section
Joel Hubbell, Groundwater Section
Robert Lowy, Surveillance Section

The purpose of this meeting was to discuss PNM's response of December 9, 1983, to NMEID's letter of November 9, 1983.

NMEID found PNM's response generally adequate but desired additional information in three areas. These concerned questions on the septic tank, Schwartzman's Pond, and records of recycled wastes. NMEID requested further written response to these questions. PNM responded verbally to these questions during the meeting and committed to supply this response in writing by December 16, 1983.

In PNM's response of December 9, 1983, a plan for further study to better define the extent of soil contaminated by material spilled from the buried storage tank at Person Generating Station was presented. NMEID found the plan as presented generally acceptable, but reserved an option to request additional coring should they believe it could provide further needed information. During this meeting, PNM committed to respond to both legal and technical questions posed by NMEID no later than December 16, 1983. They were as follows:

A. Responses needed to NMEID letter, November 9, 1983.

1. Discussion of laboratory wastes generated which go to the plant sewage treatment works (volume, concentrations, etc.).

2. Information on cooling tower operation, boiler operation, and water treatment employed in these operations. Specific interest is in quality and quantity of wastes being placed in Schwartzman's pond.

3 Records of waste material recycled from the waste tank.

B. Response needed to technical questions.

1. What is the confidence in laboratory analyses performed on the contaminated soil?

2. Soil moisture data.

3. What chemical analyses have been and will.be performed on soil samples?

4. Have blank samples been provided the laboratory for analyses? Results. What are future plans for laboratory checks?

5. A statement of strategy for future coring to be completed including why/why not will the next drilling include going to groundwater (to be discussed with EID before work begins).

6. A drawing of the facility where the spill occurred.

PNM also agreed to provide the following information by December 29, 1983:

1. Meeting minutes of December 12, 1983.

2. Verification of technical approach presented to NMEID December 16, 1983, by PNM (items B.5 above).

3. Discussion of moisture data.

4. Discussion of background data.

5. Existing well data and history.

6. How waste oils and solvents are handled at all remaining PNM generating facilities.

There being no further items to be discussed the meeting was ended.

Attachment # 2
ORIGINAL IN Hazardous
Waste Files.

SUMMARY OF PHASE I INVESTIGATIONS AT PUBLIC SERVICE COMPANY OF NEW MEXICO - PERSON GENERATING STATION, ALBUQUERQUE, NM

prepared for:

PUBLIC SERVICE COMPANY OF NEW MEXICO
ALVARADO SQUARE
ALBUQUERQUE, NM 87158

December 29, 1983

prepared by:

GEOSCIENCE CONSULTANTS
220 COPPER SQUARE
500 COPPER AVENUE NW
ALBUQUERQUE, NM 87102

Original in Hazardous
waste files

TABLE OF CONTENTS

1.0 EXECUTIVE S MARY

The first phase of the soil contamination investigation at the Person Generating Station has allowed a preliminary determination of:

--The lithology at the site (uniform sand)
--The hydrologic properties of the unsaturated zone
--The approximate vertical and lateral extent of PCE in the soil
--The concentrations of PCE in the soil
--The mechanisms for the approximate rate of movement of PCE in the unsaturated zone
--The approximate depth to groundwater (115')

The soil sampling was done in accordance with established drilling and coring procedures to assure no cross-contamination of samples and no movement of fluids down the sealed boreholes. These procedures are described in Section 2.0. Analytical procedures used to establish PCE concentrations in the soil are described in Section 3.0.

In order to evaluate the potential for the PCE described in Section 4.2 to migrate in the unsaturated zone, unsaturated hydraulic conductivities (Ku) were determined through laboratory tests. The relationship of these conductivities to measured moisture contents is described in Section 4.4. In general, it was found that unsaturated hydraulic conductivities for most of the affected zone approach zero and where they are measurable, they range from 10^{-6} to 10^{-7} cm/sec. As a result, it appears that the PCE in the unsaturated zone will remain at approximately the same vertical location with the exception of molecular/vapor phase transport.

The porosity of the sands at the site range from 22-27% which are typical values for medium-coarse grained sands. Saturated hydraulic conductivities (Ksat) determined for three samples from PS-4 averaged about .008 cm/sec.

The question of how to locate a possible background borehole and groundwater monitoring well are discussed in Sections 5.0 and 6.0. It will be necessary to complete the second phase of the investigation before these holes can be located confidently, should they be needed.

2.0 SAMPLING PROGRAM METHODOLOGY

During the period of October 24-October 27, 1983 an initial drilling and soil sampling program was carried out by PNM and Geoscience Consultants at Person Generating Station. This program consisted of drilling five hollow stem auger holes (PS-1,PS-2,PS-3,PS-4,PS-5) in the vicinity of the waste tank to depths of 50,50,60,90,90 feet respectively (Figure 2-1). These holes were sampled at 2.5' intervals with a split spoon sampler. After sample removal, the split spoon samplers were entirely disassembled and steam (250°F) cleaned and allowed to dry prior to taking another sample. The upper and lower 6 cm of a 46 cm long split spoon sample were discarded to avoid sample contamination from material that may have been present in or on the sides of the auger (Plate 1).

Immediately after splitting the core barrel, samples were taken throughout the length of the core to minimize the effect of any small difference in grain size. Samples were collected in 40 ml VOA vials for chemical analysis (Plate 2). The remainder of the samples were frozen for any future analysis that may be required. Samples were handled with disposable rubber gloves discarded after each use to prevent cross contamination.

Every 5 feet a representative sample was taken immediately after opening the core barrel for soil

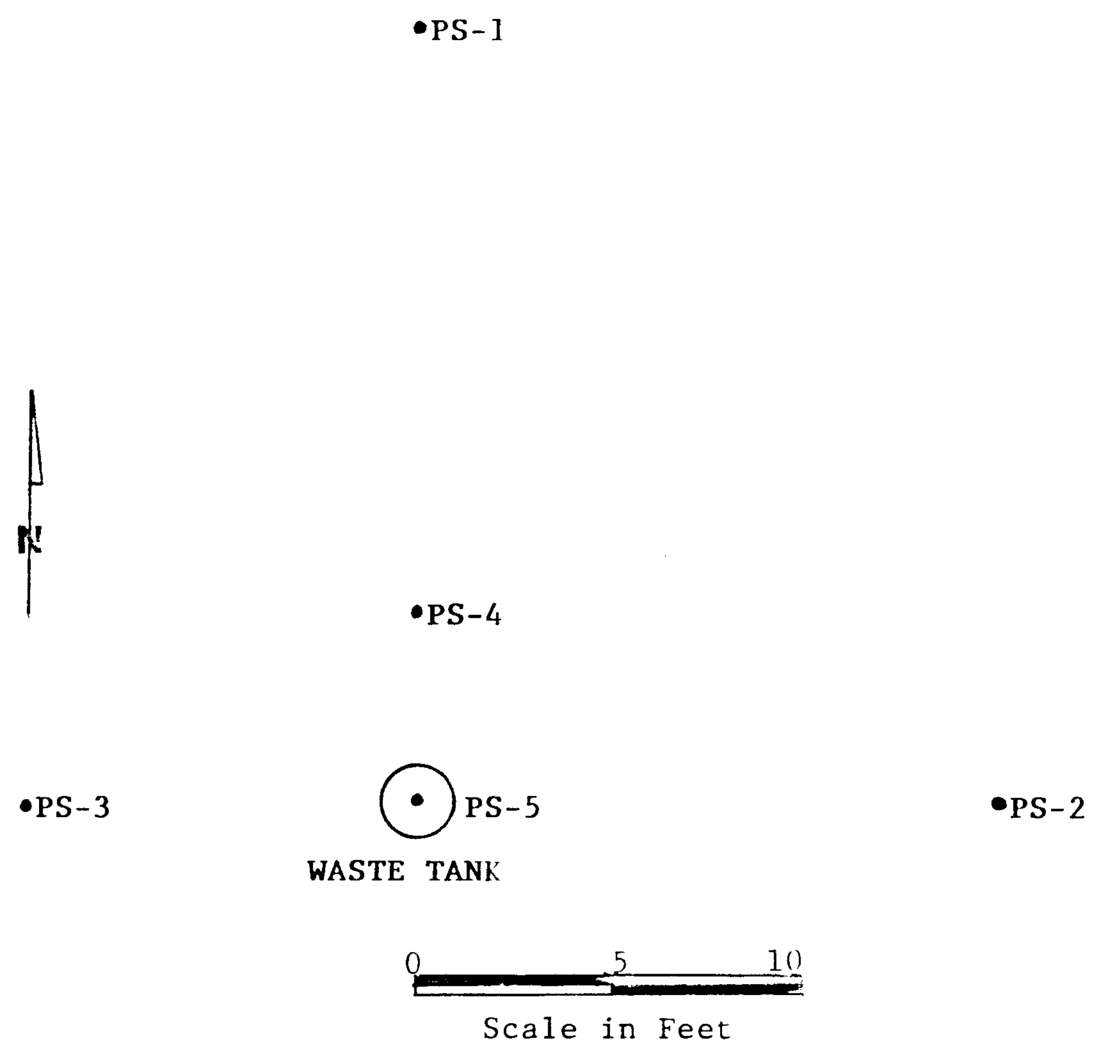


Figure 2-1 Map showing layout of Phase 1 core holes in relation to location of waste tank

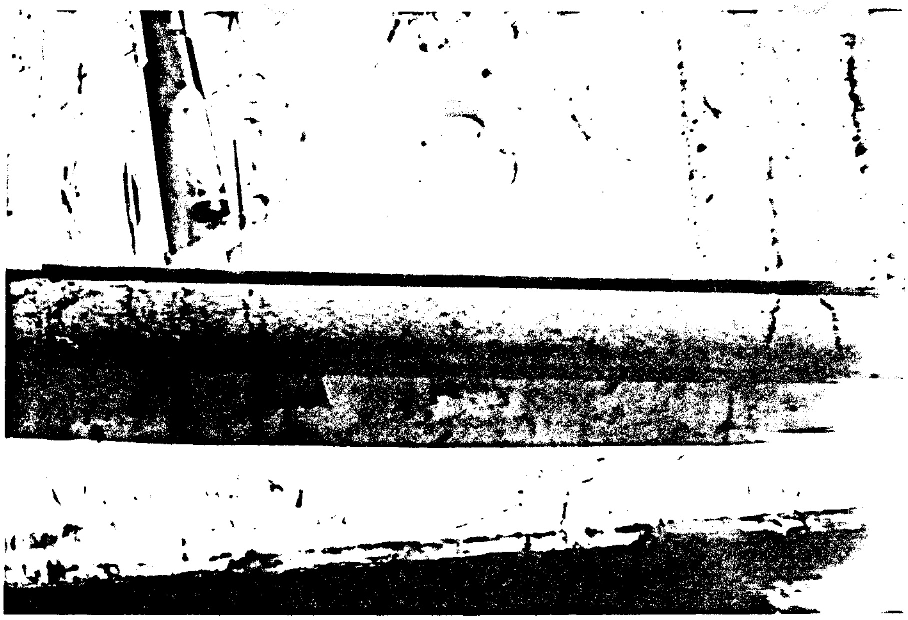


Plate 1 - Typical split spoon sample prior to removal of ends to assure no sample cross-contamination. Note uniformity of grains.

Plate 2 - Samples in 40 ml vials from entire length of core to eliminate size effect.

moisture analysis. These samples were immediately sealed in two plastic bags and mason jars to prevent moisture loss. The auger holes were backfilled with bentonite pellets and granular bentonite to seal the hole and to insure that fluids could not move down the bore hole. Samples were kept in coolers with ice and transported to the laboratory daily for analysis. Samples from depths of 25',40', and 70' in hole PS-4 were sent to Dr. Daniel B. Stephens at NMIMT for development of soil moisture characteristic curves in order to determine unsaturated hydraulic conductivity (Ku) as a function of volumetric soil moisture (θ) for the material at the site.

3.0 ANALYTICAL PROGRAM

Soil samples were analyzed for concentrations of tetrachlorethylene (PCE) and for weight percent moisture. In addition, three samples from different depths (25',40', and 70'of PS-4) were sent to Dr. Daniel B. Stephens (NMIMT) for development of soil moisture characteristic curve, Ku and Ksat determinations.

3.1 CHEMICAL ANALYSIS OF SOIL SAMPLES

Soil samples analyzed for tetrachloroethylene (PCE) were stored frozen in VOA vials until analyses were performed. In the laboratory, samples were thawed and a representative portion of the soil in the vial was extracted using methanol. The extract was analyzed using gas chromatography with electron capture detection. The procedure that was utilized is included in "Test Methods for Evaluating Solid Waste", 2nd edition, USEPA, SWER, SW846, 1982 and "Organic Analysis using Gas Chromatography/Mass Spectrometry", 1979, Budde & Eichelberger, Ann Arbor Science Press.

Replicate samples from some vials were analyzed to evaluate PCE concentration variability due to grain size variation in the vial and differences introduced by subsampling soil from the VOA vial. Since tetrachloroethylene (PCE) is the least volatile of the wastes stored in the tank, it will have a longer residence time in the soil and thus it was chosen as the most conservative organic tracer for studying the soil contamination. Soil moisture tests were done by drying the material at 75°C for 36 hours. This method assured the release of all the moisture in the sample with the exception of molecular (bound water) which does not affect unsaturated hydraulic conductivities (Ku).

3.2 UNSATURATED HYDRAULIC CONDUCTIVITY (Ku) LABORATORY DETERMINATION

Three soil samples sent to Dr. Daniel B. Stephens of NMIMT were analyzed in the laboratory to determine Ku values at depths of 25', 40', and 70'. Since the material was quite uniform throughout, the soil moisture characteristic curves did not vary greatly with depth.

All moisture content data are reported on a volumetric rather than on a mass basis. During analysis for volumetric water content and pressure head the soil remains in stainless steel rings. Two methods of analysis were employed: the hanging water column and the volumetric pressure plate extractor. Procedures for both methods follow those prescribed in Methods of Soil Analysis, American Society of Agronomy, C.A. Black, et al.(eds.), 1965. The results of the analysis are represented graphically in Section 4.3.

During the final step of determining moisture content versus pressure head the soil samples are oven dried for 24 hours at 105°C. The oven drying is necessary to calculate water contents and porosity. To determine saturated hydraulic conductivity all samples were placed in a constant head permeameter specifically designed to accommodate 100cc stainless steel rings. The samples were soaked in the permeameter for about 24 hours. Socorro city tap water was used in the permeameter. There was no evidence of piping through any of the samples. Measurements of hydraulic gradient and flow rate in the permeameter were taken within the subsequent 24 hour period.

A methodology by Mualem (WRR,12(3),1976) to determine hydraulic conductivity versus pressure head was used in conjunction with a computer program by R. van Genuchten (Princeton University, Civil Engineering Department, Research Report 78-WR-08,1978.) Data requirements for the computer model include the volumetric water content versus pressure head and saturated hydraulic conductivity. Recently reported studies and previous experience indicate that this approach provides a accurate representation of the unsaturated hydraulic conductivities (Van Genuchten, 1980, Soil Science Soc. Amer. Proc. 44(5).

4.0 ANALYSIS OF AVAILABLE DATA AND RESULTS

An analysis of the results of the Phase 1 coring, sampling, analyses, and laboratory measurements is presented in this section.

4.1 LITHOLOGIC DESCRIPTION OF SITE

The coring and logging of the five holes drilled in Phase 1 of the study indicate that the material consists of a fairly uniform, medium-coarse grained, fluvially deposited sand with some minor amounts of clay and gravel to a depth of at least 90' (depth of deepest core hole). No continuous gravel or clay lenses could be correlated between any of the holes. Within an individual core, when gravel or clay was present, the thickness never exceeded 20 cm. The grain size of sand was uniform throughout the profile. In summary, the lithology of the site is characterized by large scale homogeneity and very small scale heterogeneity consisting of clay and non-continuous gravels. No cracks or other potential fluid channels were visible in any of the cores.

4.2 RESULTS OF CHEMICAL ANALYSIS

Results of the soil samples analyzed for PCE are included in Table 4-1 and Figure 4-1. The detection limit for PCE is .001 mg/l (1ppb). Core holes PS-1 and PS-2, at

Albuquerque, NM 87105

Analytical and Environmental Services

AnaCor Laboratories

To: PNM
Alvarado Square
Albuquerque, NM 87158

Date: 8 November 1983
JV-1192 (Revised)

Attention: Jody Plum

Analyte: Tetrachloroethylene

Sample ID	Analytical Results	Sample ID	Analytical Results
1 - Surface	0.062 ppm	3 - 60'	0.032 ppm
1 - 10'	0.030 ppm	4 - Surface	0.017 ppm
1 - 20'	0.015 ppm	4 - 10'	371.5 ppm
1 - 30'	0.025 ppm	4 - 20'	230.2 ppm
1 - 40'	0.020 ppm	4 - 30'	236.8 ppm
1 - 50'	0.015 ppm	4 - 40'	263.3± 70.4 ppm
2 - Surface	0.0573 ± 0.0319 ppm	4 - 50'	305.7± 113.2 ppm
2 - 10'	0.006 ppm	4 - 60'	156.27 ppm
2 - 20'	0.003 ppm	4 - 70'	0.006± 0.002 ppm
2 - 30'	0.004 ppm	4 - 80'	0.010± 0.003 ppm
2 - 40'	0.007 ppm	4 - 90'	0.019± 0.016 ppm
2 - 50'	0.052 ppm	5 - 15'	2127.0 ppm
3 - Surface	0.009 ppm	5 - 20'	202.7 ppm
3 - 10'	0.005 ppm	5 - 30'	167.6 ppm
3 - 15'	700.0 ppm	5 - 40'	438.5± 211.0 ppm
3 - 20'	361.7 ppm	5 - 50'	295.2 ±40.0 ppm
3 - 32.5	613.0 ppm	5 - 60'	0.013 ppm
3 - 30'	405.6 ppm	5 - 70'	0.002 ppm
3 - 40'	451.8 ppm	5 - 80'	0.004± .0005 ppm
3 - 50'	18.0 ppm	5 - 90'	0.011± 0.006 ppm

Normal Detection Limit: .001 mg/l

Reference: "Test Methods for Evaluating Solid Waste", 2nd Edition, USEPA, SWER, SW846, 1982.

Table 4-1 PCE Analysis at Person Generating Station

Analyt l and Environmental Servic s

Laboratories

Date: 8 November 1983
JV- 1192

To: PNM
Alvarado Square
Albuquerque, NM 87102

Attention: Jody Plum

Analyte	Sample ID/Analytical Results			
	PS2 32.7' (0955)	PS2 22.5'	PS2 50.0' (1045)	PS2 42.5' (1025)
% Moisture	4.95 %	7.85 %	6.56 %	3.64 %

An invoice for services is enclosed. Thank you for your consideration in contacting AnaCor Laboratories.

Sincerely,

Jennifer V. Smith, Ph.D.
Laboratory Director

Enclosure

20 feet north a' ' 15 feet east respectivel' show very low levels of PCE. These levels are indicative of vapor phase transport and/or molecular diffusion and not liquid movement. These holes are outside the boundary of the soil contaminated by liquid PCE. The other three core holes (PS-3,PS-4,PS-5) show a sharp vertical concentration gradient at the 40-60 foot level which indicates that the mechanism for PCE movement below this level has been largely due to molecular diffusion and/or vapor phase transport. This is further substantiated by an examination of the low Ku values that correspond to the volumetric moisture contents (θ) encountered at these depths in all the core holes. The additional 8 core holes being drilled under Phase 2 of the investigation will provide much better definition of the soil volume contaminated by PCE.

4.3 RESULTS OF MOISTURE CONTENT TESTS

The results of the moisture content analyses performed on the samples is given in Table 4-2. This table converts the weight % moisture reported by the laboratory to the volumetric moisture content necessary to determine Ku values from soil moisture characteristic curves by using bulk density values for differing grain sizes. The results from the moisture content analyses show a uniform gradient with an average value of less than

TABLE 4-2
MOISTURE CONTENT OF UNSATUARATED ZONE
PERSON STATION

	depth	wt % fluid	ρ_B*	θ**
PS-1	30	3.67	1.6	5.8
	40	4.27	1.6	6.83
	50	2.28	1.65	3.76
			av. θ =	5.4
PS-2	22.5	7.85	1.5	11.8
	32.5	4.95	1.6	7.9
	42.5	3.64	1.65	6.0
	50.00	6.56	1.5	9.8
			av. θ =	8.9
PS-3	30	3.14	1.65	5.2
	40	3.81	1.65	6.3
	50	2.87	1.65	4.7
	60	5.74	1.5	8.61
			av. θ =	6.2
PS-4	5	3.15	1.65	5.2
	10	3.98	1.65	6.6
	15	5.6	1.65	9.2
	20	6.67	1.5	10.00
	25	5.08	1.65	8.4
	30	5.78	1.5	8.7
	35	9.24	1.4	12.9
	40	4.32	1.6	6.48
	50	4.93	1.65	8.1
	60	5.11	1.65	8.4
	70	5.19	1.6	8.3
	80	7.06	1.5	10.6
	90	5.69	1.65	9.4
			av. θ =	9.0
PS-5	15	4.45	1.7	7.6
	20	5.18	1.5	7.7
	25	5.89	1.5	8.8
	30	7.13	1.5	10.7
	35	7.05	1.5	10.6
	40	4.43	1.65	7.3
	45	5.28	1.5	7.9
	50	6.68	1.5	10.2
	60	3.42	1.6	5.6
	70	3.10	1.7	5.3
	80	2.39	1.6	3.8
	90	2.76	1.7	4.7
			av. θ =	7.5

*ρ_B = Bulk Density (g/cc) (determined from field observations of grain size verified by lab tests)
**θ = Volumetric Moisture Content (%)

9 %. These volumetric moisture contents yield very low Ku values when using data developed from the three samples taken at various depths (25',40', and 70') in PS-4.

4.4 RELATIONSHIP OF MOISTURE CONTENT (θ) TO UNSATURATED HYDRAULIC CONDUCTIVITY (Ku)

The relationship of volumetric moisture content (θ) to unsaturated hydraulic conductivity (Ku) was determined for the soil at the Person Generating Station site through the laboratory analysis described in Section 3.2. The soil moisture characteristic curves shown in Figures 4-2, 4-3, and 4-4 were used to determine Ku values for each interval where moisture content analyses were performed. Ku values determined through this method generally approach zero and in the few instances where Ku values are greater than zero, only two or three values exceed 10^{-7} cm/sec (Figures 4-2, 4-3, 4-4). These values are about 6 x 10^{-6} cm/sec. All of the lab determined Ku values tend to be higher than actual field conditions since the technique in Section 3.2 yields maximum values.

4.5 POROSITY AND SATURATED HYDRAULIC CONDUCTIVITY (Ksat)

The porosity of the sands at the site range from 22-27% which are typical values for medium-coarse grained sands. Saturated hydraulic conductivities were calculated

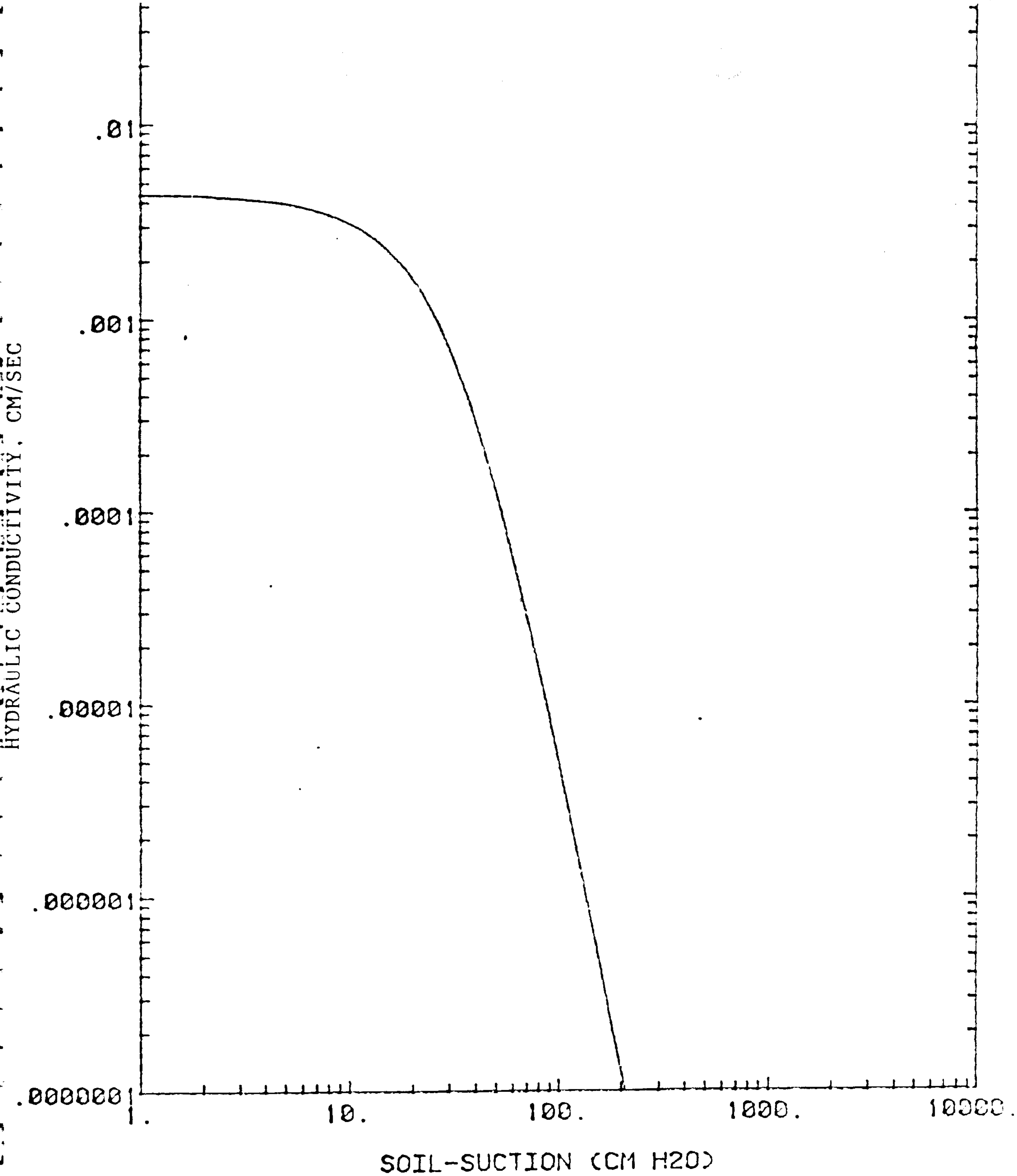


Figure 4-2A PS-4 25'

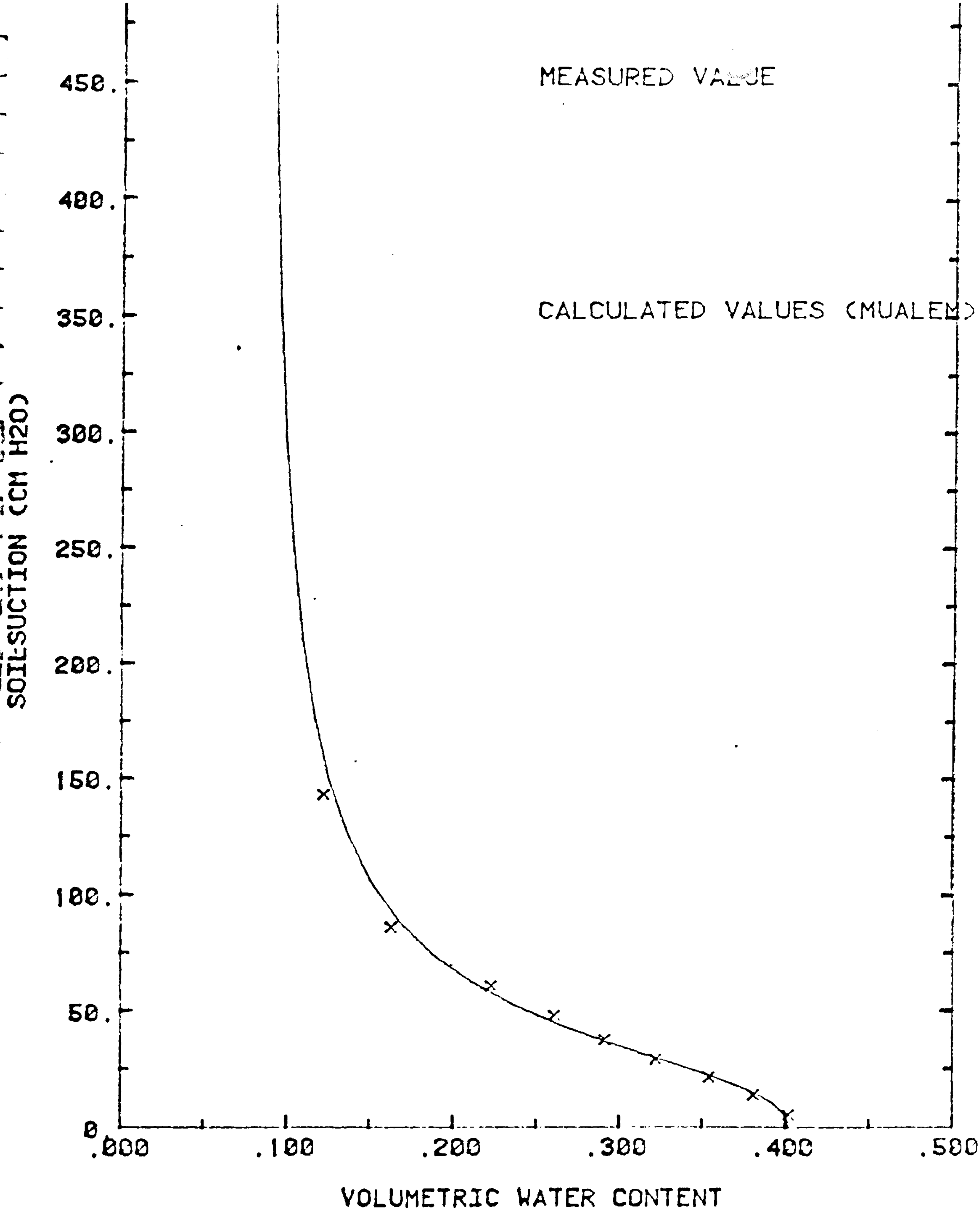


Figure 4-2B PS-4 25'

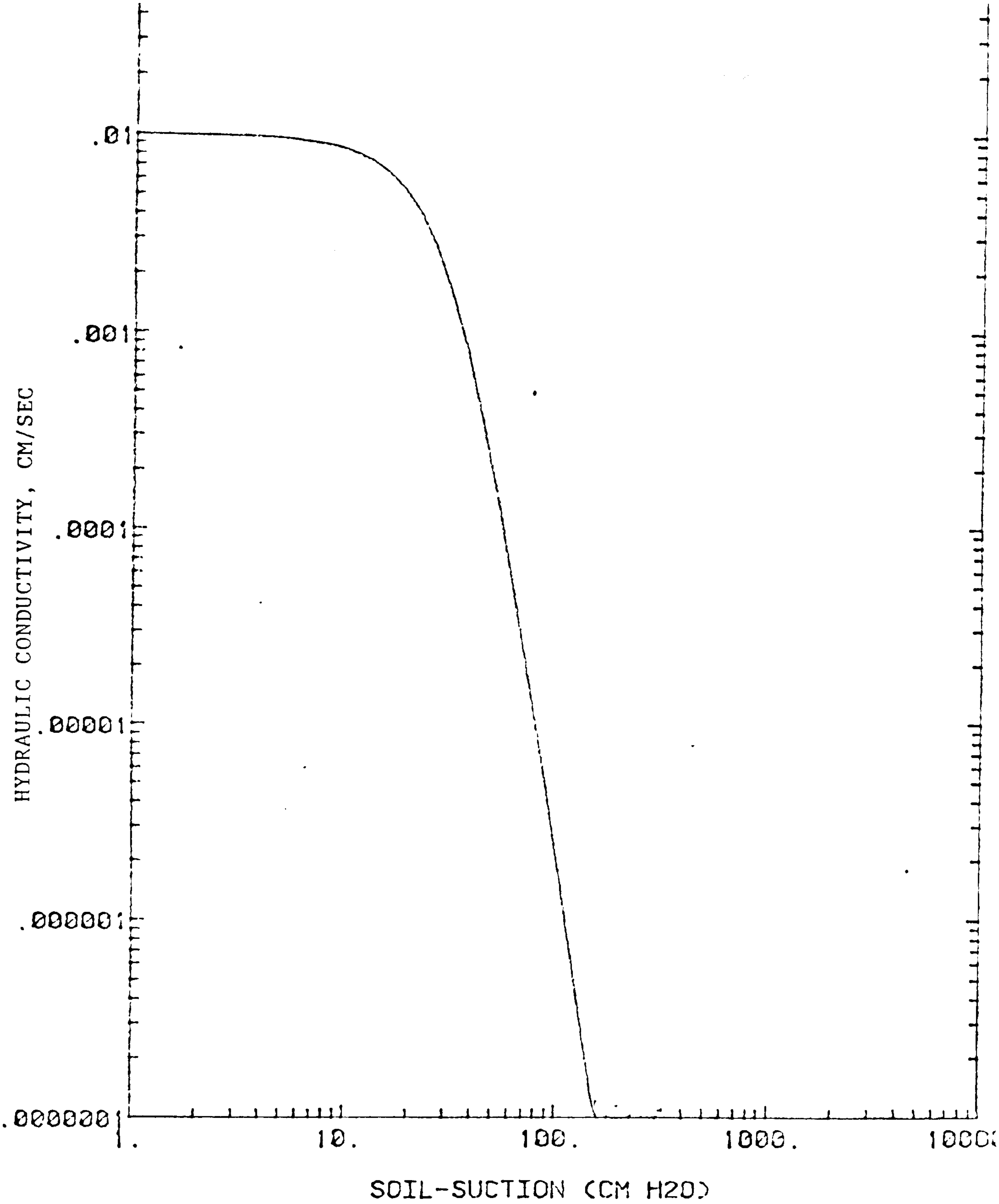


Figure 4-3A PS-4 40'

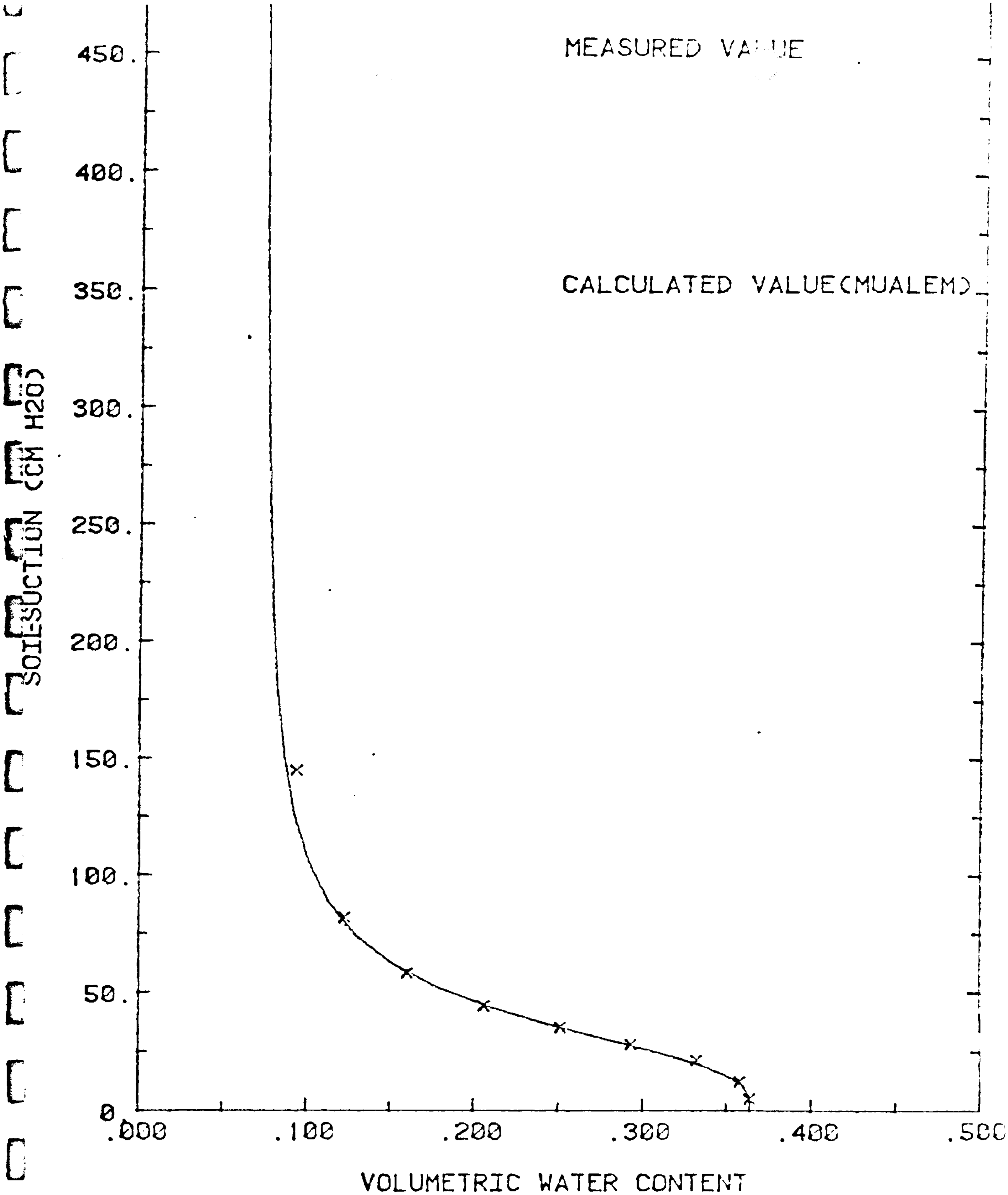


Figure 4-3B PS-4 40'

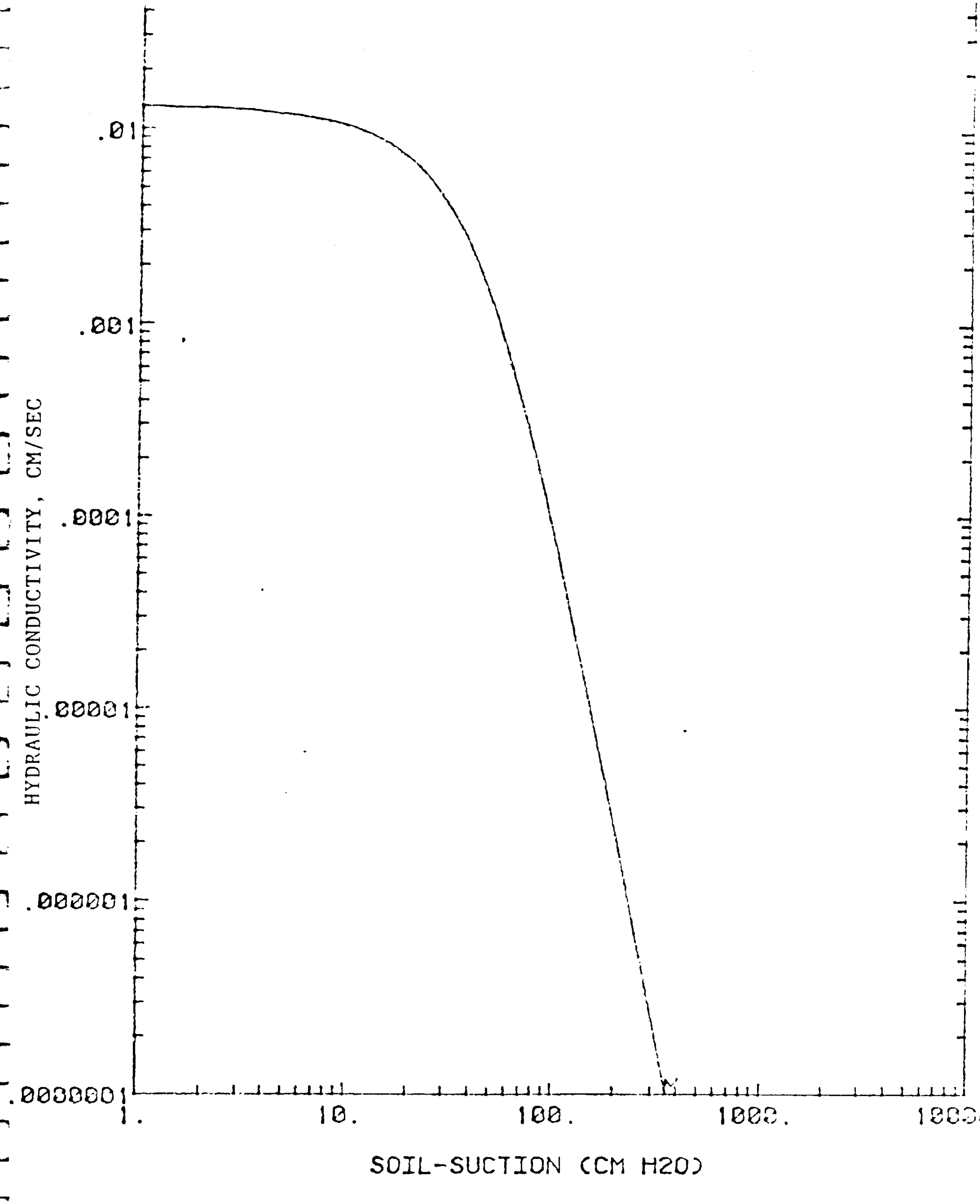


Figure 4-4A PS-4 70'

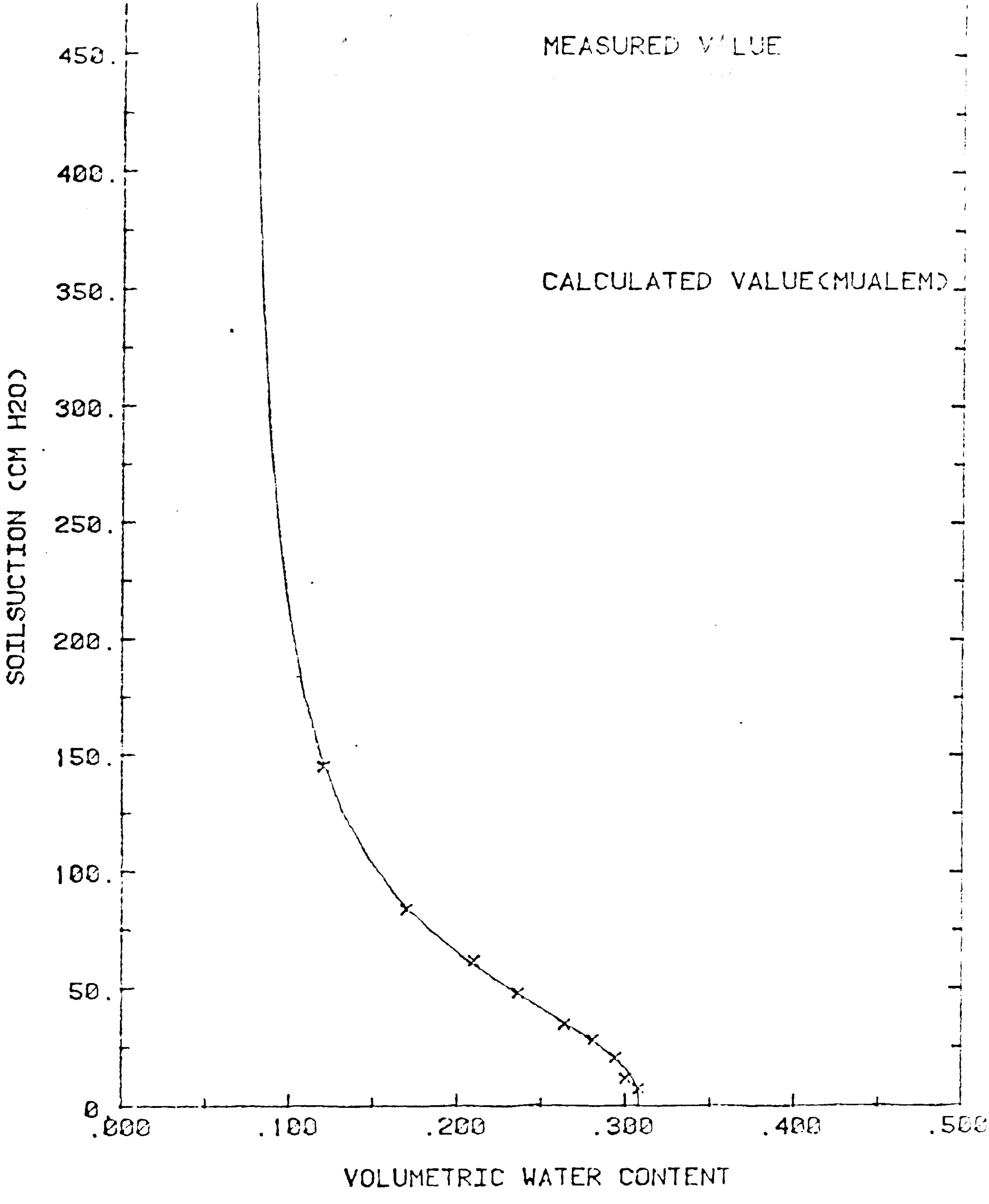


Figure 4-4B PS-4 70'

by wetting samples slowly with a constant head apparatus manufactured by kelkamp Equipment for Soi Research. Samples were wetted slowly from below to reduce entrapped air content. Saturated hydraulic conductivities (Ksat) determined with the above described method for three samples from PS-4 averaged .008 cm/sec.

4.6 MOVEMENT OF CONTAMINANT (PCE)

Movement of PCE in the unsaturated zone can take place through two principal mechanisms:

--Unsaturated Fluid Flow
--Molecular Diffusion/Vapor Phase Transport

4.6.1 Unsaturated Fluid Flow

The low Ku values obtained through the lab analysis of samples indicate that most of the contamination present in the soil beneath the waste tank at Person Generating Station can not presently be moving at any measurable rate through the unsaturated zone. Some redistribution of moisture in the profile may occur as zones that have greater than an average volumetric moisture content (8.33) drain at rates that may approach 10^{-7} cm/sec.

4.6.2 Molecular Diffusion/Vapor Transport

The low concentration observed indicate that the movement of PCE in the soil also occurs by a combination of vapor phase movement and molecular diffusion. This mechanism is much slower than unsaturated fluid flow and is not capable of creating very elevated concentrations. This is evidenced by the low concentrations in PS-1 and PS-2 and below the 60' interval in the other core holes.

5.0 SELECTION OF A BACKGROUND BOREHOLE

The results of the Phase 2 drilling currently underway will enable the selection of a suitable background site that will be sufficiently close to the tank so as to be representative and yet outside influence of the PCE in the vapor phase. It is impossible to locate such a background hole at present due to the non-symmetry of PCE distribution observed in the Phase 1 sampling. The increased accuracy in determining the shape and extent of PCE in the soil will allow the selection of a background bore hole site.

6.0 GROUNDWATER SAMPLING AND LOCATION OF GROUNDWATER MONITORING WELL

The standard techniques used thus far for soil sampling and described in Section 2.0 are not suitable for obtaining a representative grab sample of groundwater due to the high probability of contamination of the sample from contact with the inside and outside of the hollow stem auger. The proper procedure for sampling the groundwater in this situation (where maximum possible concentrations expected are near the detection limit) would be to establish the local groundwater gradient in the area and to properly install and develop a groundwater monitoring well downgradient from the plume.

In an attempt to establish the hydraulic gradient at the site, water levels were taken from some deep wells (Figure 6-1) that exist at Person Generating Station. Water level measurements from these wells indicate that the gradients, although small, are not as expected in the area. This is due to the fact that these wells have been used as production wells and some still continue to be pumped on a daily basis. Therefore, static water levels are difficult to establish. The appropriate method for establishing the gradient in the vicinity of the tank would be to drill exploratory wells outside the plume and perform a 3 point problem. In order to accomplish this, the results from the Phase 2 drilling must be analyzed to determine the limits of the contaminated soil. Once the gradient is determined, a representative downgradient monitoring well location could be selected.

PERSON GENERATING STATION
RESULTS OF PHASE 1 ANALYSES
TETRACHLOROETHYLENE(ppm)

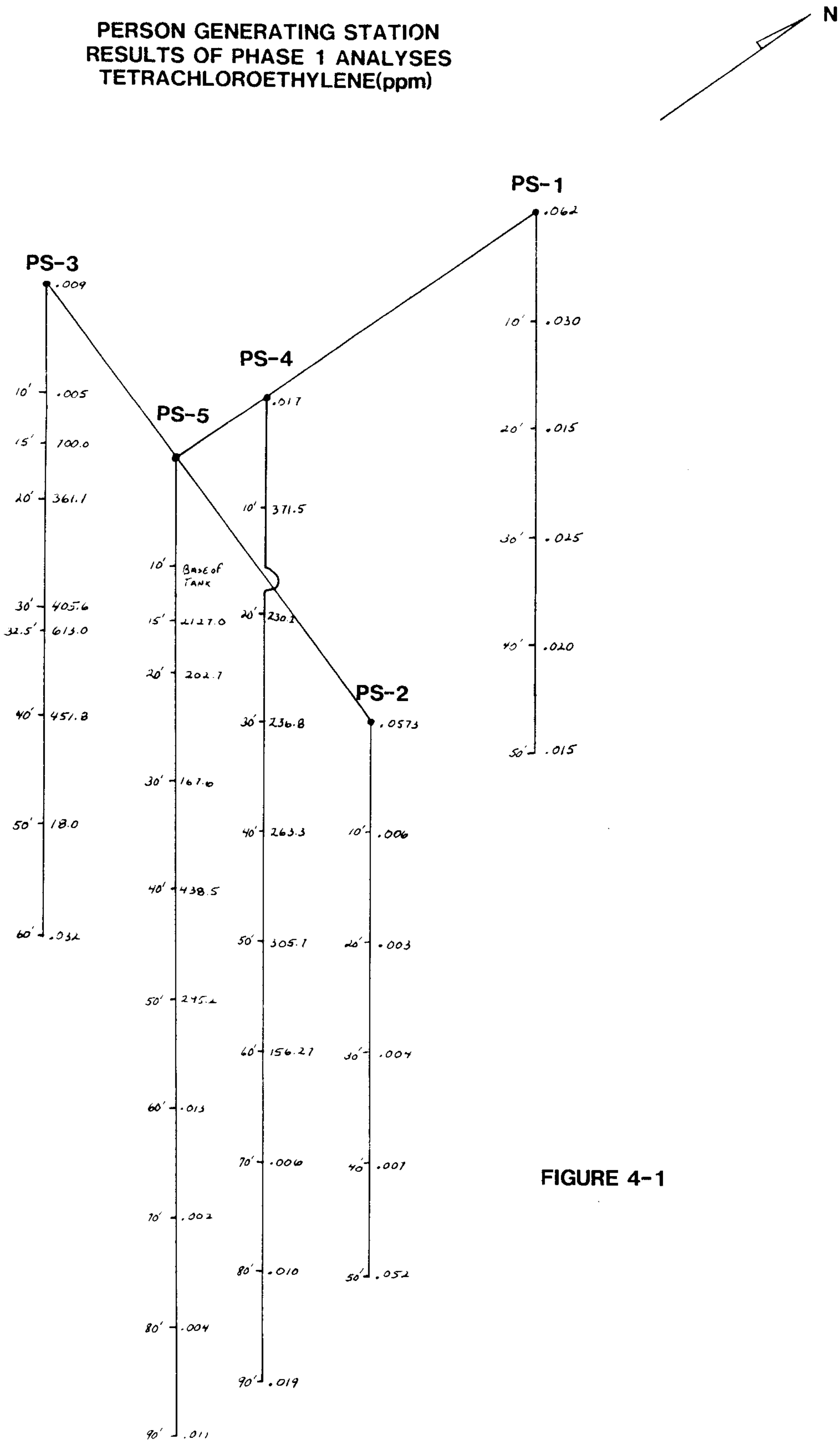


FIGURE 4-1

PERSON GENERATING STATION
RESULTS OF PHASE 1 ANALYSES
TETRACHLOROETHYLENE(ppm)

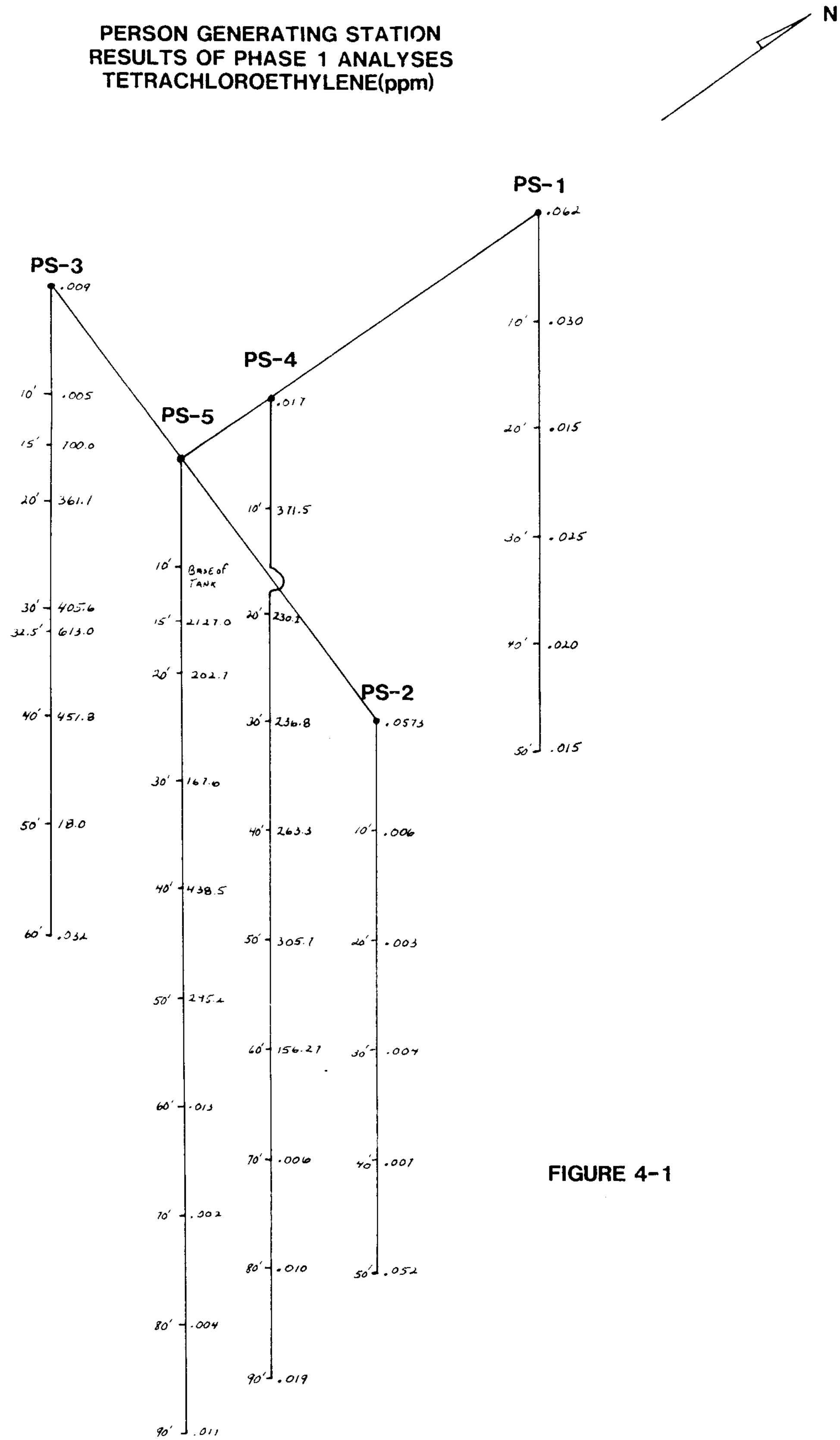
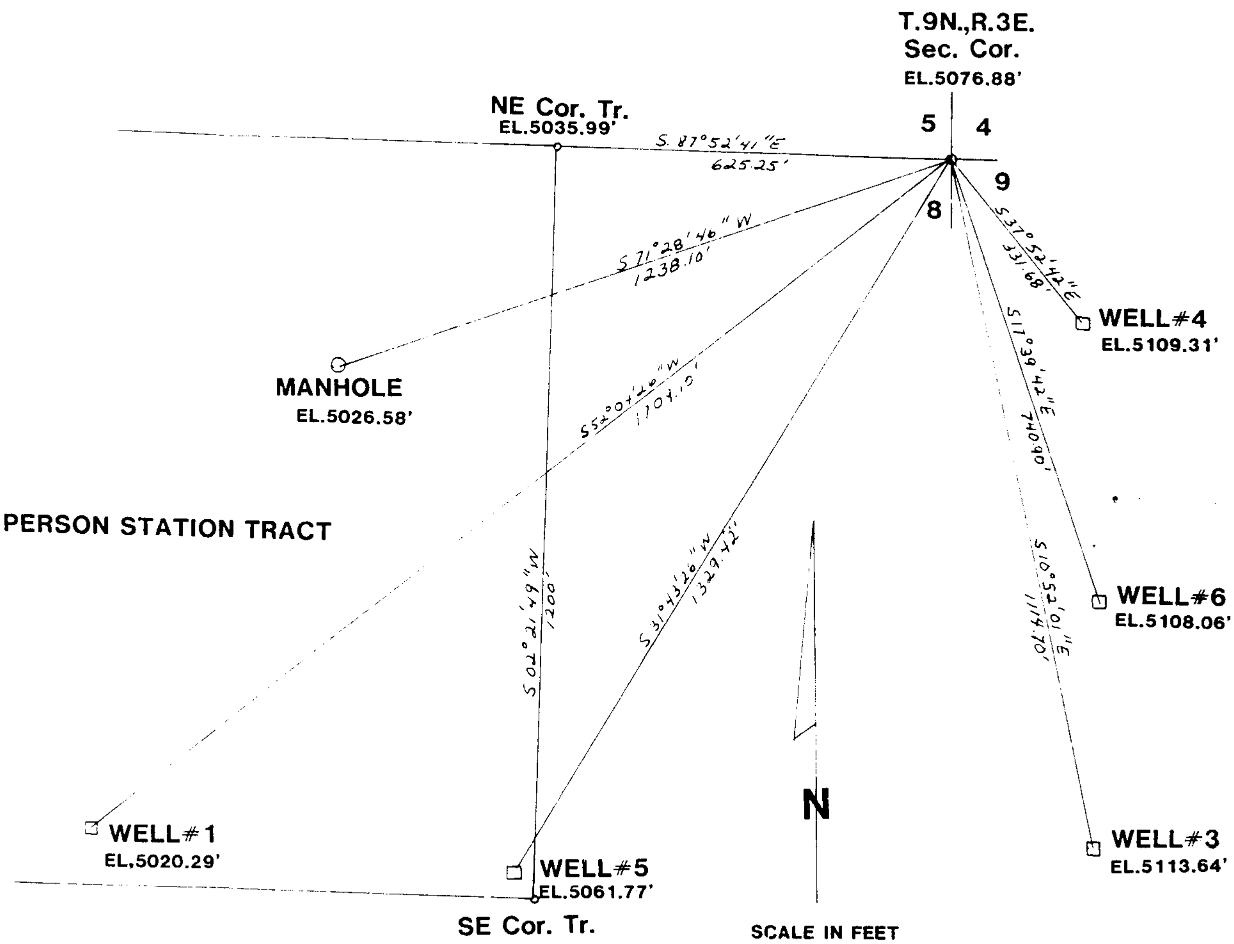


FIGURE 4-1

PERSON STATION SURVEY

NOVEMBER 15, 1983



STATIC WATER LEVELS

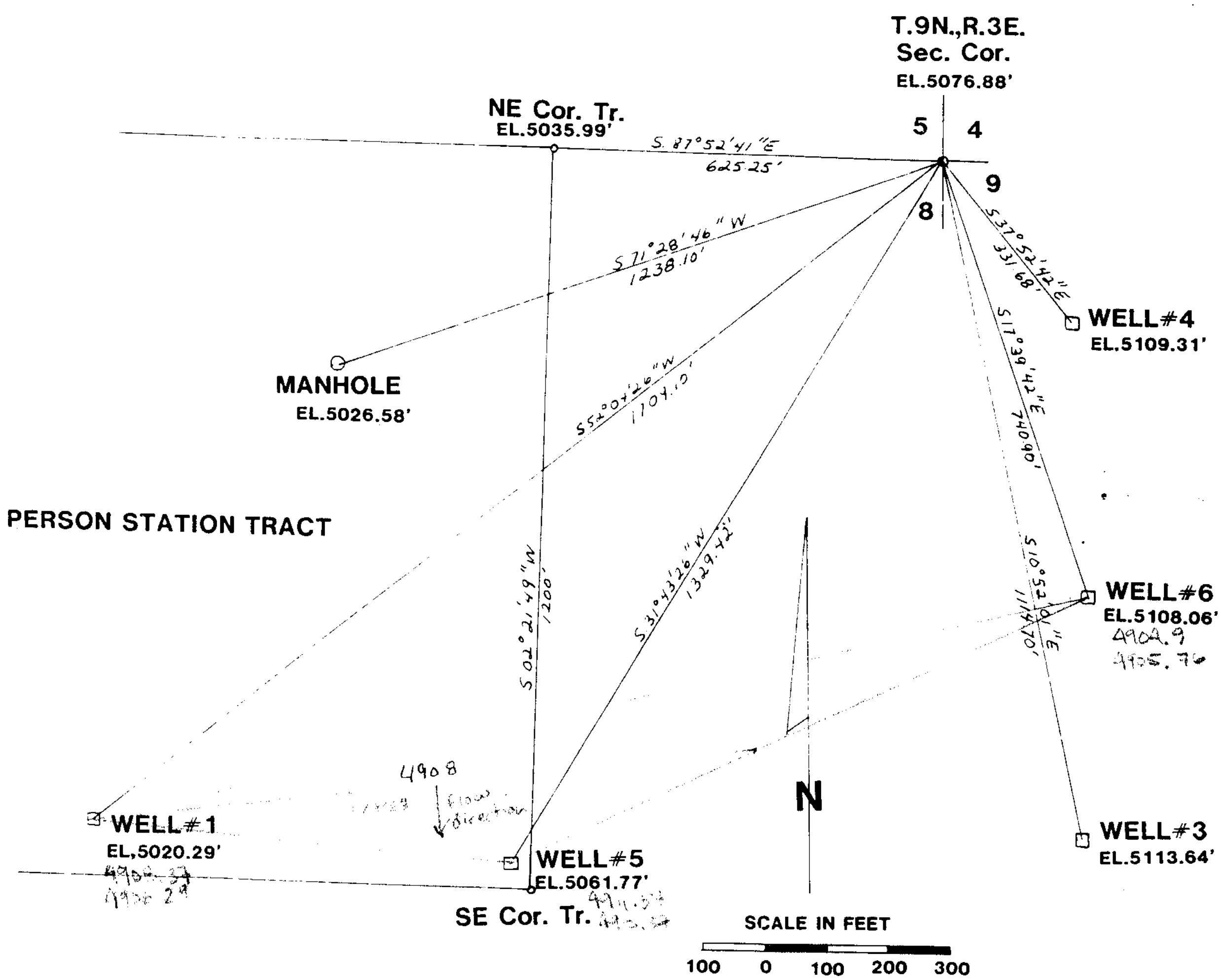
ELEVATION

		WELL#1	WELL#5	WELL#6
DATE	11/9/83	4908.37'	4911.37'	4904.9'
	12/6/83	4906.29'	4910.57'	4905.76'

FIGURE 6-1

PERSON STATION SURVEY

NOVEMBER 15, 1983



STATIC WATER LEVELS

ELEVATION

		WELL#1	WELL#5	WELL#6
DATE	11/9/83	4908.37'	4911.37'	4904.9'
	12/6/83	4906.29'	4910.57'	4905.76'

FIGURE 6-1

GEOLOGIC DESCRIPTION OF PERSON STATION WELL-FIELD AREA

The geologic material occurring beneath the Person Station well-field area consists of the unconsolidated, interbedded deposits of sand, sandy-gravel, and sandy-clay of the Santa Fe Geologic Group. Individual beds are generally of lenticular nature, range in thickness from 5 to 100 feet, and are difficult to correlate laterally over distances of more than 200 to 300 feet.

Review of historical static water level data indicates that the water table slopes gently to the west at a gradient of approximately 1.5 percent. However, the available water level information from which this gradient was derived spans a period of 17 years and has not been adjusted for well drawdown interference or seasonal recharge conditions. Therefore, the degree of accuracy of this water table gradient is unknown.

Review of the drillers' geology logs retained in PNM's files for the five Person Station cooling water wells indicates that a correlatable clay deposit generally appears to separate an upper aquifer zone from a lower aquifer zone. This clay deposit occurs at depths ranging from approximately 350 to 600 feet beneath the plant area. Groundwater obtained from the lower aquifer zone generally exhibits a lower dissolved solids content than water obtained from the shallower aquifer. This preliminary evaluation of aquifer characteristics was limited to the lower aquifer because water hardness limitations for cooling purposes will, in the future, require groundwater production to be limited to the lower aquifer zone in order to prevent scaling problems caused by utilizing water from the harder, upper aquifer. Because PNM has primarily been concerned with the water-bearing nature of the geologic material beneath the site, the bulk of the hydrogeologic data that PNM has compiled to date relates to the deeper geologic deposits occurring beneath the water table.

Review of available drillers' logs also indicates that variations in aquifer characteristics occur beneath the power plant site. The attached Table 1 shows a breakdown in the types of geologic material occurring at each well site. The geologic materials occurring at the sites of Wells 1, 2, and 5 generally contain less than 40 percent sand with the remainder of the material being composed of clay and clayey sand. In contrast, the sites for Wells 3, 4, and 6 generally exhibit more than 45 percent sand with the remainder being composed of clay and clayey sand. Table 1 also shows the tested yield of each well in gallons per minute (gpm) and the normalized yield of each well expressed in terms of gpm per foot of aquifer exposed. These normalized values also indicate that the locations of Wells 3, 4, and 6 possess greater potential for groundwater production than do the locations of Wells 1, 2, and 5. The fact that Well 2 has been abandoned would tend to support this conclusion.

During February and March of 1981, a deep high capacity well (Well 6) was constructed and pump tested at the Person Station site. Well 6 is located at the top of the hill adjacent to I-25 and is situated midway between Wells 3 and 4. A continuous section of Johnson well screen was installed in Well 6 at a depth ranging from 515 to 815 feet. Short-term, two-hour duration step pumping tests were conducted at 500, 1,000, and 1,500 gpm. A long-term continuous pumping test was then conducted at 2,000 gpm for approximately 54 hours. The following text provides a brief description of the deep aquifer zone conditions determined through the Well 6 pumping test.

To determine aquifer properties of transmissivity and storage coefficient, as well as determining aquifer hydrogeology, it is necessary to treat an aquifer as an ideal homogeneous medium, infinite in lateral extent, which releases water from storage instantaneously with decline in head and which receives no recharge. Utilizing these assumptions, Theis, in 1935, developed a method to analyze aquifer pump test data for transmissivity and storage using heat flow as an analogy. Cooper and Jacob, in 1946, presented a simplified solution to the Theis' method. Both methods were developed and are used for analyzing drawdown data in confined aquifers. The methods can be used in unconfined situations provided that the drawdowns in the well during aquifer pumping are small compared with the aquifer thickness or the unconfined aquifer is thick and the screened section is placed in the lower part of the aquifer.

Theis' plots of drawdown versus time for Wells 6 and 4 were analyzed by using a standardized Theis curve provided by Prickett (1965). The plotted data for Well 4 was somewhat scattered, making selection of a match point somewhat unreliable.

Plotting of drawdowns for analysis by the Cooper-Jacob method was possible only for Well 6. Drawdowns recorded at Well 6 included drawdown interference due to assumed steady-state pumping of Well 4 at approximately 2,000 gpm over the period 1958 through 1981. This drawdown interference is approximately 23.4 feet and is revealed in the static water level reading in Well 6 prior to the start-up of the pumping test. The data points of this plot were considered valid only after 156 minutes of continuous discharge at 2,000 gpm. Plotting data from Well 4 for analysis by the Cooper-Jacob method was not possible because of the large distance between Wells 4 and 6 (445 feet). This distance invalidated the constraint of the Theis well variable (u) being less than or equal to 0.01 within the cumulative time limit of the continuous discharge pumping portion of the pump test phase.

If the drawdown data from Well 4 was more reliable and less scattered, either one of these cases could be identified by the trend of the Theis data plot during the pumping portion of the pump test phase. However, interpretation of the geologic logs of both Wells 6 and 4, the geophysical data suite of Well 6, and to some extent the relation illustrated in the residual drawdown recovery plot for Well 6, tentatively indicate the presence of a semi-impermeable, 30-foot thick clay layer. There is possible vertical transmission of groundwater from an overlying shallow water table aquifer to the aquifer which Well 6 penetrates.

Four transmissivity values and one storage coefficient were derived from the time-drawdown, residual drawdown data analysis. The arithmetic mean value of transmissivity is 40476.9 gallons per day per foot (gpd/ft). The value of storage derived from curve matching analysis of drawdown data in Well 4 is 0.05, which falls in the semiconfined aquifer range.

TABLE I

Summary of Aquifer Characteristics for Person Station Wells[1]

Well Number	Total Sand Content: Feet	Total Sand Content: % of Total	Total Clayey-Sand Content: Feet	Total Clayey-Sand Content: % of Total	Total Clay Content: Feet	Total Clay Content: % of Total	Total Yield (gpm)	Normalized Yield (gpm/foot)
1	129	33	224	57	39	10	1,030	2.6
2	31	8	336	88	14	4	860	2.3
3	262	83	53	17	0	0	1,500	4.8
4	90	47	103	53	0	0	2,000	10.4
5	98	25	280	70	21	5	600[2]	1.5
6	ND	ND	ND	ND	ND	ND	2,000	6.7

[1] Characteristics shown for the lower aquifer only.

[2] Yield after void zone was plugged with drilling mud.

ND indicates value not determined.

ATTACHMENT 4

DESCRIPTION OF PERSON STATION PRODUCTION WELLS

Well Number	Installation Date	Well Description
1	1952	Blank casing from top to 299 ft.; screened from 299-300 ft.; blank casing from 300-619 ft.; screened from 619-643 ft.; blank casing from 643-718 ft.; gravel plug 718-728 ft. Pipe diameter is 12-3/4 inches.
2	No information available - well no longer in service.	
3	1953	Blank casing from top to 320 ft.; screened from 320-555 ft.; blank casing from 555-630 ft.; screened from 630-920 ft.; open bore hole from 920-1025 ft. Pipe diameter is 12-3/4 inches.
4	1956 (?)	Blank casing from top to 350 ft.; screened from 350-400 ft.; blank casing from 400-439 ft.; screened from 439-460 ft.; blank casing from 460-480 ft.; screened from 480-500 ft.; blank casing from 500-510 ft.; screened from 510-640 ft.; blank casing from 640-776 ft.; screened from 776-815 ft.; blank casing from 815-874 ft.; screened from 874-884 ft.; blank casing from 884-900 ft. Pipe diameter is 12-3/4 inches.
5	No information available - well no longer in service.	
6	1981	Blank casing from top to 515 ft.; screened from 515 to 815 ft.

ATTACHMENT 5

Waste Oil Recycling at PNM Generating Facilities

Public Service Company of New Mexico generating facilities produce various volumes of waste oils during normal day-to-day operations. These oils can come from maintenance of equipment, lubrication in motors, collected greases, equipment washing, leaking seals, or contaminated fuels. These oils are collected by various means and then stored in drums or tanks until sufficient volume is on hand to warrant pickup by a fuel oil recycler. Waste oil recyclers which have collected this waste include Lubbock Oil Company, Mesa Oil Company, and General Crude Processing.

Records of such transactions are attached for your review. These records indicate the dates and volume received and amount paid. These records are inclusive of waste oils generated within the PNM system.

PUBLIC SERVICE COMPANY OF NEW MEXICO

JE907—ENTRY FOR ACCOUNTS RECEIVABLE

DIVISION	WRITTEN BY	MONTH DAY YEAR 9-14
Albuquerque	E Gavnatte	01 07 83

NAME Mesa Oil

DOCUMENT NO

ADDRESS

CITY

STATE

ZIP

QUANTITY	DESCRIPTION	AMOUNT
589	Oil, Scrap	136.45
	TAX	5.80
	TOTAL	142.25

PRIMARY 15-19	D 20	S 21	TYPE 27		AMOUNT 45-57
14300	1	0	4	TYPE 0 - M/J 2 - EMPL. CASH ITEM 4 - CUST. ITEM	142.25

EMPLOYEE NAME (LAST, FIRST) 58-76	DES CODE 78-79	EMP. NO 84-88

NOTE NAME MUST APPEAR EXACTLY AS IT APPEARS ON PAYROLL HRS FILE

PRIMARY 15-19	DIV 20	SUB 21	SECONDARY 22-25	SUB 26-28	FUNC 29-31	AMOUNT 45-57
16450	0	0	6480	100	140	136.45
24105	1	0		VERIFIED NO. 2		5.80
					TOTAL	142.25

WHITE - GEN. ACCOUNTING
PINK - DIV. ACCOUNTING

016623
TICKET NUMBER 39-44

PNM 420 11 81

PUBLIC SERVICE COMPANY OF NEW MEXICO

JE907—ENTRY FOR ACCOUNTS RECEIVABLE

DIVISION	WRITTEN BY	MONTH DAY YEAR 9-14
Albuquerque	G Garamitto	0 9 2 1 8 3

NAME

DOCUMENT NO

ADDRESS Mesa Oil

CITY

STATE

ZIP

QUANTITY	DESCRIPTION	AMOUNT
750	gal Scrap oil @ .24	180 00
	TAX	Exempt
	TOTAL	180 00

PRIMARY 15-19	D 20	S 21	TYPE 27	TYPE 0 - M/J 2 - EMPL. CASH ITEM 4 - CUST. ITEM	AMOUNT 45-57
14300	1	0	4		180 00

EMPLOYEE NAME (LAST, FIRST) 58-76	DES CODE 78 79	EMP. NO 84-88

NOTE NAME MUST APPEAR EXACTLY AS IT APPEARS ON PAYROLL HRS FILE

PRIMARY 15-19	DIV 20	SUB 21	SECONDARY 22-25	SUB 26-28	FUNC 29 31	AMOUNT
18480	0	0	8480	100	140	180 00
24105	1	0				
					TOTAL	180 00

WHITE - GEN. ACCOUNTING
PINK - DIV. ACCOUNTING

017771

TICKET NUMBER
39-44

#7

PNM 420 11/81

PUBLIC SERVICE COMPANY OF NEW MEXICO

JE907—ENTRY FOR ACCOUNTS RECEIVABLE

DIVISION	WRITTEN BY	MONTH DAY YEAR 9-14
Albuquerque	C. Jaramillo	05 01 82

NAME Mesa Oil Inc.

DOCUMENT NO

ADDRESS

CITY

STATE

ZIP

QUANTITY	DESCRIPTION	AMOUNT	
	Salvaged Oil	145	76
	TAX	5	81
	TOTAL	151	57

PRIMARY 15-19	D 20	S 21	TYPE 27	TYPE Ø - M/J 2 - EMPL. CASH ITEM 4 - CUST. ITEM	AMOUNT 45-57	
14300	1	0	4		151	57

EMPLOYEE NAME (LAST, FIRST) 58-76	DES CODE 78-79	EMP. NO 84-88

NOTE NAME MUST APPEAR EXACTLY AS IT APPEARS ON PAYROLL HRS FILE

PRIMARY 15-19	DIV 20	SUB 21	SECONDARY 22-25	SUB 26-28	FUNC 29-31	AMOUNT 45-57	
18480	0	0	8480	100	147	145	76
24105	1	0				5	81
					TOTAL	151	57

WHITE - GEN. ACCOUNTING
PINK - DIV. ACCOUNTING

011569

TICKET NUMBER
39-44

PNM 420 11 81

PUBLIC SERVICE COMPANY OF NEW MEXICO
JE907—ENTRY FOR ACCOUNTS RECEIVABLE

DIVISION	WRITTEN BY	MONTH DAY YEAR 9-14
Albuquerque	C Jaramillo	12 27 82

NAME Mesa Oil Inc

DOCUMENT NO

ADDRESS

CITY

STATE

ZIP

QUANTITY	DESCRIPTION	AMOUNT
73 gts	Waste oil	175 06
	TAX	7 44
	TOTAL	182 50

PRIMARY 15-19	D 20	S 21	TYPE 27	TYPE Ø - M/J 2 - EMPL. CASH ITEM 4 - CUST. ITEM	AMOUNT 45-57
14300	1	0	4		182 50

EMPLOYEE NAME (LAST, FIRST) 58-76 | DES CODE 78-79 | EMP NO 84-88

NOTE: NAME MUST APPEAR EXACTLY AS IT APPEARS ON PAYROLL HRS FILE

PRIMARY 15-19	DIV 20	SUB 21	SECONDARY 22-25	SUB 26-28	FUNC 29-31	AMOUNT 45-57
19480	0	0	8480	100	140	175 06
24105	1	0				7 44
					TOTAL	182 50

WHITE - GEN. ACCOUNTING
PINK - DIV. ACCOUNTING

016532
TICKET NUMBER 39-44

PUNCHED NO. 2
VERIFIED NO. 7

PNM 420 11/81

PUBLIC SERVICE COMPANY OF NEW MEXICO

JE907—ENTRY FOR ACCOUNTS RECEIVABLE

DIVISION	WRITTEN BY	MONTH DAY YEAR 9-14
Albuquerque	G Caramelli	06 23 83

NAME

ADDRESS Mesa Oil

CITY

DOCUMENT NO

STATE | ZIP

QUANTITY	DESCRIPTION	AMOUNT
300	gallon used oil	71.94
	TAX	3.06
	TOTAL	75.00

PRIMARY 15-19	D 20	S 21	TYPE 27	TYPE Ø - M/J 2 - EMPL. CASH ITEM 4 - CUST. ITEM	AMOUNT 45-57
14300	1	0	4		75.00

EMPLOYEE NAME (LAST, FIRST) 58-76 | DES CODE 75-79 | EMP. NO 84-88

NOTE: NAME MUST APPEAR EXACTLY AS IT APPEARS ON PAYROLL HRS FILE

PRIMARY 15-19	DIV 20	SUB 21	SECONDARY 22-25	SUB 26-28	FUNC 29-31	AMOUNT
18403	0	0	1874	900	142	71.94
24105	1	0				3.06
					TOTAL	75.00

WHITE - GEN. ACCOUNTING
PINK - DIV. ACCOUNTING

PUNCHED NO

017437
TICKET NUMBER 39-44

PNM 420 11-81