See Pocket for encl.

WM-RES
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D102
NWCI

WM Project 10, 11, 16
Docket No.
PDR ✓
LPDR ✓ (B,N,S)

NUCLEAR WASTE CONSULTANTS INC.
8341 So. Sangre de Cristo Rd.
Littleton, Colorado 80127
(303) 973-7495

Distribution:
Pohle

(Return to WM, 623-SS)

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May 2, 1986
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009/3.2/DBS.001
RS-NMS-85-009
Communication No. 53

U.S. Nuclear Regulatory Commission
Division of Waste Management
Geotechnical Branch
MS-623-SS
Washington, DC 20555

Attention: **Mr. Jeff Pohle, Project Officer**
Technical Assistance in Hydrogeology - Project B (RS-NMS-85-009)

Re: **SALT Data Inventory and Management Report - Subtask 3.2**

Dear Mr. Pohle:

This cover letter transmits to the NRC staff the Data Inventory and Management Report for Salt, Subtask 3.2 of Contract No. RS-NMS-85-009. As directed by the NRC Site Lead for Salt, the effort to date concentrates on information from the Palo Duro Basin, Texas. This report has been prepared by the Drs. Dan Stephens and Fred Phillips, Mr. Robert Knowlton, and Ms. Catherine Carlson (Daniel B. Stephens and Associates), all members of the site team for Salt. The report has received a management and technical review by Mark Logsdon of Nuclear Waste Consultants.

A computerized database is used for the management of the library of available information to allow for rapid search and retrieval of information by key words as well as citation and authors. The bibliography includes references to informal and formal document reviews.

Two types of data base are considered useful for purposes of evaluating DOE'sd conceptual models and constructing numerical and analytical models. The first type of data base is a hard-copy filing system, including copies of data in the following categories:

1. Borehole Test Data
2. Hydraulic Head Data
3. Miscellaneous Hydrologic Data
4. Hydrochemistry Data
5. Geologic Data.

The second type of data base is a computerized version of selected elements of the data compiled in the hard-copy filing system. Separate computerized data bases have been compiled for the first four categories, using LOTUS 1-2-3.

The DBS/NWC team wishes to re-emphasize that these data bases are designed and prepared to meet specific technical requirements of Project B and are not viewed by DBS and NWC as comprehensive data bases for the Palo Duro Basin, those being the responsibility of the Department of Energy.

Nuclear Waste Consultants, Inc.

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See D1021 5/2/86
Jeff Pohle
Salt Data Inventory

Attachments 1-4 of the DBS report present listings of the data entered into the computerized data bases and examples of the LOTUS 1-2-3 graphical representations. Attachment 5 is the updated DBS bibliography. Attachment 6 is an example of thekind of informal document review that DBS staff prepare when reading Salt documents.

DBS/NWC anticipates that these products - and the data management approach on which they are based - will evolve with the project, rather than become obsolete. In particular, the Salt team anticipates that the data inventory and management system will be used as the basis for assembling and documenting the data needed to perform Subtask 3.4, Conceptual Model Evaluations.

The submission of this letter report meets the contractual deliverable for Subtask 3.2 of Contract Number RS-NMS-85-009 and completes the Salt Data Inventory and Management subtask requirements at this time. Per the terms of the contract, DBS/NWC will submit regular updates of this report.

If you have any questions concerning this report or related matters, please contact me immediately.

Respectfully submitted,
NUCLEAR WASTE CONSULTANTS, INC.

Mark J. Logsdon

Mark J. Logsdon, Project Manager

Att: Salt Data Inventory and Management Report, Subtask 3.2

cc: US NRC - Director, NMSS (ATTN: PSB)
DWM (ATTN: Division Director) - 2
Mary Little, Contract Administrator
WMGT (ATTN: Branch Chief)

M. Galloway, TTI
L. Davis, WWL

bc: R. Knowlton, DBS

DANIEL B. STEPHENS & ASSOCIATES, INC.
CONSULTANTS IN GROUND-WATER HYDROLOGY

• GROUND-WATER CONTAMINATION • UNSATURATED ZONE INVESTIGATIONS • WATER SUPPLY DEVELOPMENT •

May 1, 1986

Nuclear Waste Consultants, Inc.
8341 S. Sangre de Cristo Road
Littleton, Colorado 80127

Att: Mark Logsdon, Project Manager

Re: Data Inventory and Management, Subtask 3.2

Dear Mr. Logsdon,

The enclosed document serves as our report for Subtask 3.2, Data Inventory and Management, as required by our subcontract to Nuclear Waste Consultants. This report describes and presents the data bases that have been generated for the Palo Duro Basin bedded salt site, and presents examples of how they may be used. The data inventory and management system will be updated on a periodic basis, as required in the contract.

If you have any questions with regard to this work, please do not hesitate to call.

Yours truly,
Daniel B. Stephens & Associates, Inc.

Robert G. Knowlton, Jr.

Robert G. Knowlton, Jr.
Project Manager

600 NEEL AVENUE SOCORRO, NEW MEXICO 87801 (505) 835-3162

INTRODUCTION

The data inventory and management system developed by the Daniel B. Stephens & Associates, Inc. (DBS) team is tailored to meet specific goals within our contract with the NRC, Project RS-NMS-85-009. The data inventory and management system is viewed as a tool which may better aid us in evaluating the conceptual models that DOE has put forth, and to assist us in the numerical and analytical modeling tasks to come. We would like to stress that this system was not formulated as a comprehensive data base, but rather designed and prepared to meet specific technical needs on this project. The data base should, however, be useful to others with directives similar to ours. The focus of our investigation to date has been on the Palo Duro Basin bedded salt site in the Texas Panhandle, as directed by the NRC staff. The data included in this data inventory and management system was derived from reports that are in the DBS library of documents and therefore may not be complete. The data base system will continue to be updated as more reports are sent to us.

DATA BASE DESCRIPTION

A two-fold approach was taken in designing the data base inventory and management system. Two types of data bases were consi-

dered useful for purposes of evaluating DOE's conceptual models and constructing numerical and analytical models. The first type of data base is a hard-copy filing system, and the second is a computerized version of some of the elements included in the hard-copy filing system.

For the hard-copy filing system, information presented in basic data reports, studies, or modeling reports has been copied directly, with important data highlighted, and placed in a filing system according to specific categories. It should be noted that not all the information available in these reports is very well documented, and therefore may not be amenable to presentation in this data inventory and management system. The hard-copy filing system should provide easy access to needed information while performing review work or preparing a computer model. Subject matter covered in this filing system includes the following:

1. Borehole Test Data
2. Hydraulic Head Data
3. Hydrologic Data
4. Hydrochemistry Data
5. Geologic Data

Much of the data included in the first four categories also lends itself to the computerized data base. Categories 1 through 4 will be discussed in more detail later as they pertain to the computerized data base. The fifth category, Geologic Data, is comprised chiefly of maps and figures which do not lend themselves well to computerization. Included within this group are representations of well stratigraphy, fractures, lineaments,

potentiometric surfaces, and salt dissolution zones.

Separate computerized data bases have been generated for the first four categories listed above using LOTUS 1-2-3 on a COMPAQ computer, an IBM compatible. LOTUS 1-2-3 is menu driven and easy to use. Some of the features that it possesses are: spreadsheet capabilities, graphics representation, and mathematical and statistical operations. These last two features include calculations, frequency distributions, ranking and culling of data, and regression analyses. LOTUS 1-2-3 can also interchange information from different data bases for comparison purposes. This allows us to generate several relatively small data bases, rather than one cumbersome large one. Updating the data base should therefore be easier to handle. Also adding new macros to help manipulate the data is a task that can be performed at any time.

The four categories included in this computerized data base are described below. Attachments 1 through 4 contain listings of the data entered in these data bases, as well as a few examples of what LOTUS 1-2-3 can provide in the way of graphical representations.

BOREHOLE TEST DATA

The information provided from single borehole hydraulic test data

for various wells in the Palo Duro Basin has been incorporated into the Borehole Test Data file. Information regarding the well name, unit name, test interval, initial and final shutin pressures, temperature, porosity, and permeability are included in the data base. Only DOE related data has been included in this data base; there are no oil and gas well data included. Attachment 1 presents the data included in this data base. Also included in Attachment 1 are examples of LOTUS 1-2-3 grapics: shut-in and ending pressures versus depth, and permeability versus depth.

HYDRAULIC HEAD DATA

A relatively large amount of equivalent fresh-water hydraulic head data has been presented in the literature. The data incorporated in the Hydraulic Head Data Base is currently confined to only that data which comes from DOE boreholes. At a later date we may consider it useful to add in other sources of head data for the purpose of constructing potentiometric head maps. Data included in this data base includes the testhole name, location, date of measurement, unit name, measurement interval, and water level elevation. Attachment 2 presents this data as it currently exists in this data base, along with a key to some of the abbreviations used.

HYDROLOGIC DATA

The Hydrologic Data Base contains hydraulic information obtained from in-situ pumping tests, laboratory tests, and the scientific literature as it relates to certain formation intervals. Some generic or textbook values referenced by the Texas Bureau of Economic Geology in their modelling studies were also referenced. Included in this data set is the well name, location, test type, unit name, permeability, hydraulic conductivity, porosity, specific storage, transmissivity, and a reference to the source of the data. Attachment 3 contains the data set as it currently exists, along with a plot of porosity versus depth, and a histogram of the frequency distribution of permeability.

HYDROCHEMISTRY DATA

Data pertaining to the chemistry and isotopic composition of water in the DOE testholes throughout the Palo Duro Basin has been incorporated into the Hydrochemistry Data Base. Data included in this file includes the testhole name, unit name, test interval, temperature, pH, Eh, conductivity, TDS, major cations, major anions, trace metals, and isotopic concentrations.

Attachment 4 presents the contents of this data base, along with a graph of Ca, Na, and Cl concentrations versus depth in one well.

DBS DOCUMENT BIBLIOGRAPHY

Since the completion of the Site Familiarization Subtask 3.1, the DBS team has received numerous additional documents for our permanent library on Salt related work. The bibliography is updated on a monthly basis, with weekly update memos presented to appropriate staff members during the month. The bibliography has been generated on the Wordperfect word processor. Keyword searches and the culling of certain documents is done with relative ease. The bibliography also contains references to the DBS team member who requested the document, the reviewer's name, and the date of any in-house informal review that was done on a document. A reference to formal reviews done on documents will also be added at a later date. Attachment 5 presents an updated version of the DBS bibliography.

INFORMAL REVIEWS

Throughout the familiarization phase, and continuing on through the life of the this project, the DBS team has been and will

continue to read documents on an informal basis to familiarize ourselves with certain aspects of the Palo Duro Basin and Salt related topics. The DBS team has been keeping a short informal review on each of the documents that are read. These reviews are loosely structured and generally contain a summary of the document and any comments that the reader feels are appropriate. These reviews are intended for in-house use only, and should allow the DBS team to share knowledge on any subject more easily without having to rely on each team member reading all documents of interest. Attachment 6 presents an example of one of these informal reviews.

SUMMARY

The DBS team's data inventory and management system is set up in two different mediums: a hard-copy filing system and a computerized data base. The hard-copy filing system should be an effective aid to our review and modeling activities. It also provides ease of access to geologic information that does not lend itself well to computerization, such as maps of well stratigraphy, fractures, lineaments, potentiometric surfaces, and salt dissolution zones. The computerized data bases are set up on LOTUS 1-2-3, are menu driven, and easy to use. Some of the benefits to using this system include: spreadsheet capabilities, graphics representation, mathematical operations, and the

interchanging of data between data bases. Both the hard-copy filing system and the computerized data bases are easily updated, and easy to modify. Again it should be stressed that this system was not formulated as a comprehensive data base, but rather designed and prepared to meet specific technical needs on this project.

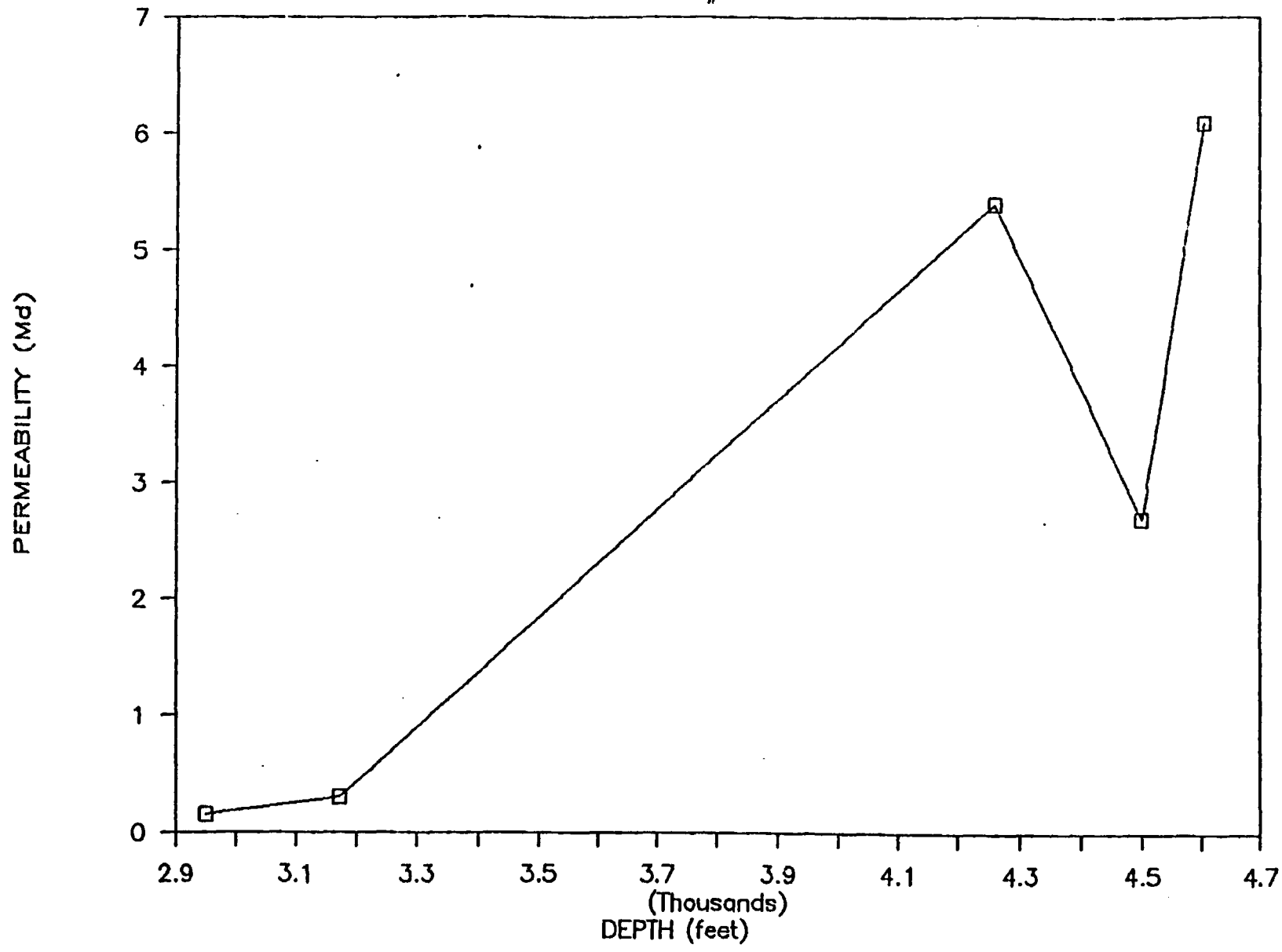
ATTACHMENT 1

BOREHOLE TEST DATA

TEST HOLE	DATE	REFERENCE ELEV	TEST DEPTH TOP	TEST DEPTH BOTTOM	UNIT	MEAS TYPE	RATING	SHUTIN PRESSURE DATA STPRESS	EDPRESS	DURATION	TEMP F	POROSITY %	PERM MD	COMMENTS	REFERENCE
DET#1	4/10/82	3861.9	1160	1340	USA	DST		ERR	ERR	ERR					BMI/SRP 5008
DET#1	4/30/82	3861.9	2749	2839	LSA	DST		160	951	359.58	76		0.16	SALT	BMI/SRP 5008
HAR#1	9/6/82		2840	2906	LSA	DST		153	1127	301.44	120	10	0.011	DOLOMITE	BMI/SRP 5004
HAR#1	9/6/82	3542	2830	3050	LSA	DST		290	11220	297.87	98	10	0.186	BROWN DOLOMITE	BMI/SRP 5004
JFR#1	11/13/82		1279	1444	USR	DST		165	457	180:58	74	15		UNSUCCESSFUL TEST	BMI/SRP 5011
JFR#1	10/31/82	4012	787	850	DOC	DST		568	575	84.62	80	30		SANTA ROSA	BMI/SRP 5011
JFR#1	10/31/82	4012	958	1216	DOC	DST		562	547	94.03	80	25		SANTA ROSA	BMI/SRP 5011
JFR#1	1/20/83	4016	5630	5909	WOLF	DST		776	1687	111.28	96	20	1.03		BMI/SRP 5011
JFR#1	11/30/82		2753	2830	LSA	DST		101	923	309.47	80	6		BROWN DOLOMITE	BMI/SRP 5011
JFR#1	2/25/83	4016	7472	7781	PENN	DST						12		GRANITE WASH	BMI/SRP 5011
SAU#1	8/19/81	2589.6	2950	3123	WOLF	DST					112		0.15		BMI/SRP 5006
SAU#1	2/15/82	2589.6	4404	4440	PENN	DST							0.3	ELLENBURGER	BMI/SRP 5010
SAU#1	4/20/82	2589.6	4500	4510	PENN	DST							5.4	MISSISSIPPIAN LIM	BMI/SRP 5010
SAU#1	5/7/82	2589.6	4258	4342	PENN	DST							2.7	GRANITE WASH	
SAU#1	6/15/82	2589.6	3172	3189	WOLF	DST							6.1		BMI/SRP 5010
ZEX#1	4/20/82	3420.2	1019	1144	DOC	DST					86			SALADO	BMI/SRP 5009
ZEX#1	4/21/82	3420.2	1019	1144	DOC	DST		155	169	120.48	86			SALADO	BMI/SRP 5009
ZEX#1	5/27/82	3420.2	3035	3097	LSA	DST		78	281	377.59	90			DOLOMITE	BMI/SRP 5009
ZEX#1	5/28/82	3420.2	2927	3103	LSA	DST					90		0.2508		BMI/SRP 5009
ZEX#1	5/28/82	3420.2	2927	2972	LSA	DST		110	1169	349.32	90			DOLOMITE	BMI/SRP 5009
ZEX#1	7/2/82	3420.2	5345	5542	WOLF	DST		1749	1841	239.44	103	10	6.77		BMI/SRP 5009
ZEX#1	8/8/82	3420.2	7144	7225	PENN	DST		829	2472	40.63	138	10	2.829		BMI/SRP 5009

DEPTH VS PERMEABILITY

SAWER #1

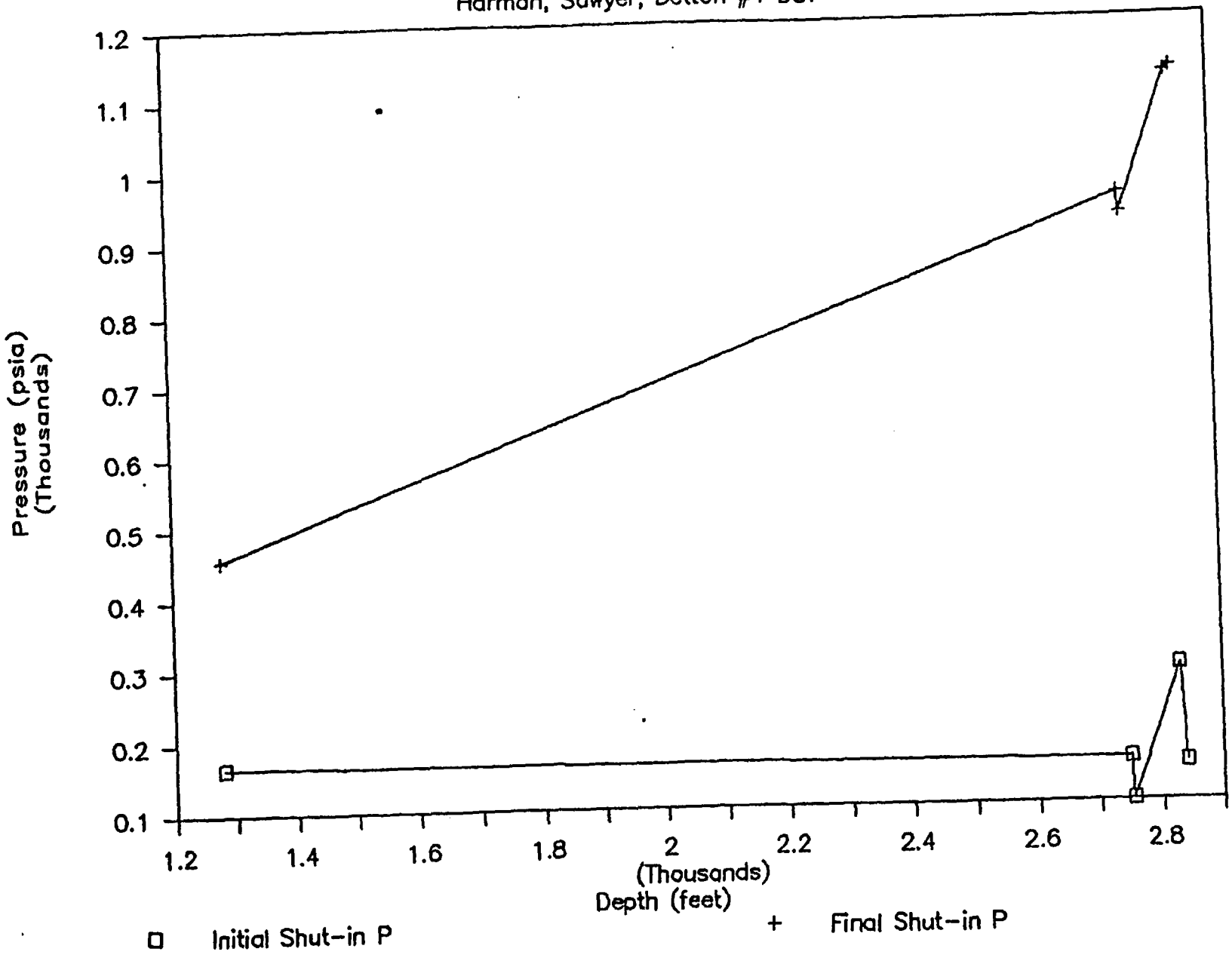


BOREHOLE TEST DATA

TEST HOLE	DATE	REFERENCE ELEV	TEST DEPTH TOP	TEST DEPTH BOTTOM	UNIT	MEAS TYPE	RATING	PERM Md	COMMENTS	REFERENCE
SAW#1	8/19/81	2589.6	2950	3123	WOLF	DST		0.15		BMI/SRP 5006
SAW#1	2/15/82	2589.6	4604	4640	PENN	DST		0.3	ELLENBURGER	BMI/SRP 5010
SAW#1	4/20/82	2589.6	4500	4510	PENN	DST		5.4	MISSISSIPPIAN LIM	BMI/SRP 5010
SAW#1	5/7/82	2589.6	4258	4342	PENN	DST		2.7	GRANITE WASH	
SAW#1	6/15/82	2589.6	3172	3189	WOLF	DST		6.1		BMI/SRP 5010

San Andres Fm Pressures

Harman, Sawyer, Detton #1 DST



BOREHOLE TEST DATA

TEST HOLE	DATE	REFERENCE ELEV	TEST DEPTH TOP	TEST DEPTH BOTTOM	UNIT	MEAS TYPE	RATING	SHUTIN PRESSURE DATA STPRESS	SHUTIN PRESSURE DATA EDPRESS	SHUTIN PRESSURE DATA DURATION	COMMENTS	REFERENCE
DET#1	4/10/82	3861.9	1160	1340	USA	DST		ERR	ERR	ERR		BMI/SRP 5008
DET#1	4/30/82	3861.9	2749	2839	LSA	DST		160	951	359.58	SALT	BMI/SRP 5008
HAR#1	9/4/82		2840	2906	LSA	DST		153	1127	301.44	DOLOMITE	BMI/SRP 5004
HAR#1	9/6/82	3542	2830	3050	LSA	DST		290	1120	297.87	BROWN DOLOMITE	BMI/SRP 5004
JFR#1	11/13/82		1279	1464	USR	DST		165	457	180.58	UNSUCCESSFUL TEST	BMI/SRP 5011
JFR#1	11/30/82		2753	2830	LSA	DST		101	923	309.47	BROWN DOLOMITE	BMI/SRP 5011

ATTACHMENT 2

Hydraulic Head Legend

DST = Drill Stem Test
Test Hole = Stone and Webster well number; county-number
Latitude and Longitude in degrees
Surface Elevation relative to mean sea level (feet)
Top/Bottom = depth of tested interval below ground surface (feet)
Water Level = Equivalent fresh water head (feet)

Unit = Geologic unit tested
- LSA = Lower San Andres (Permian)
- LSA4 = Lower San Andres Unit #4 Dolomite (Permian)
- Miss = Mississippian System
- Penn = Pennsylvanian System
- Qu/G = Queen/Grayburg Formation (Permian)
- Wich = Wichita Group (Permian)

HYDRAULIC HEAD DATA 1985

TEST HOLE	TEST DATE	LOCATION LAT	LOCATION LONG	SURFACE ELEV	INTERVAL TOP	INTERVAL BOTTOM	UNIT	WL ELEV msl	REFERENCE
Bri-001	61	34.73282	101.45847	3254.0	6406.0	6520.0	Penn	1226.0	BMI/ONWI-566
Bri-011	67	34.58574	101.08630	2306.0	5970.0	6014.0	Penn	1732.0	BMI/ONWI-566
Bri-021	70	34.34615	101.33902	3266.0	6344.0	6411.0	Wolf	2946.0	
Bri-021	70	34.34615	101.33902	3266.0	6340.0	6411.0	Wolf	2540.0	
Cas-001	59	34.72496	102.48157	3913.0	6909.0	7059.0	Wolf	2553.0	
Cas-007	66	34.64046	102.02042	3711.0	5183.0	5228.0	Wolf	2747.0	
Cas-007	66	34.64046	102.02042	3711.0	5838.0	5940.0	Wolf	2158.0	
Cas-010	70	34.51755	102.32645	3855.0	6762.0	6782.0	Wolf	2455.0	
Cas-010	70	34.51755	102.32645	3855.0	6762.0	6782.0	Wolf	2238.0	
Dea-032s	82	34.97330	102.21987	3808.0	2600.0	2710.0	LSA4	3403.0	
Dea-033s	82	34.93560	102.36510	3847.0	2749.0	2839.0	LSA4	3707.0	
Dea-036s	83	35.06280	102.46000	4016.0	5630.0	5909.0	Wolf	2245.0	
Dea-036s	83	35.06280	102.46500	4016.0	5630.0	5909.0	Wolf	2200.0	
Flo-001	70	34.24600	101.24820	3187.0	4633.0	4706.0	Wich	2214.0	
Flo-004	64	34.18440	101.24210	3170.0	4675.0	4736.0	Wich	1949.0	
Flo-004	64	34.18440	101.24210	3170.0	5101.0	5153.0	Wolf	1828.0	
Flo-005	69	34.18420	101.24800	3191.0	9136.0	9158.0	Miss	2156.0	
Flo-009	69	34.12900	101.36380	3268.0	7609.0	7783.0	Penn	1404.0	
Flo-013	69	33.98199	101.32320	3158.0	8350.0	8524.0	Penn	3668.0	
Flo-014	69	33.92641	101.53160	3224.0	8432.0	8616.0	Penn	2131.0	
Flo-023	76	33.90199	101.37740	3162.0	7924.0	8050.0	Miss	1999.0	
Flo-027	66	33.83020	101.30299	3111.0	6665.0	6710.0	Penn	1962.0	
Flo-028	65	33.87959	101.28710	3105.0	6866.0	6890.0	Penn	1664.0	
Flo-038s	77	34.30643	101.31654	3258.0	12.0	5581.0	Wolf	2118.0	
Flo-038s	77	34.30643	101.31654	3258.0	5500.0	5581.0	Wolf	2118.0	
Hale-006	67	34.11000	101.89300	3444.0	7864.0	8036.0	Wolf	2648.0	
Hale-006	67	34.11000	101.89300	3444.0	7864.0	8036.0	Wolf	2561.0	
Hale-014	61	33.99150	102.06630	3492.0	6400.0	6510.0	Wich	2529.0	
Hale-014	61	33.99150	102.06630	3492.0	7255.0	7301.0	Wolf	2560.0	
Hale-014	61	33.99150	102.06630	3492.0	9445.0	9473.0	Miss	2560.0	
Hale-033	72	33.84880	101.73599	3280.0	8282.0	8306.0	Penn	4848.0	
Hale-034	62	33.89529	101.75050	3319.0	7992.0	8073.0	Penn	1298.0	
Hale-041	61	33.84599	101.83369	3343.0	6630.0	6685.0	Wich	2316.0	
Hale-041	61	33.84599	101.83369	3343.0	9128.0	9148.0	Penn	2282.0	
Hale-042	59	33.83270	101.85460	3344.0	6510.0	6535.0	Wich	2452.0	
Hale-042	59	33.83270	101.85460	3344.0	9166.0	9185.0	Penn	2395.0	
Hale-042	59	33.83270	101.85460	3344.0	11299.0	11345.0	Miss	2076.0	
Hale-049	64	33.84290	102.03880	3416.0	6690.0	6703.0	Wolf	2544.0	
Hale-050	72	33.89960	102.04111	3427.0	7290.0	7350.0	Wolf	2386.0	
Hale-071s	76	33.89760	102.03810	3336.0	6815.0	6844.0	Wolf	2400.0	
Hale-x02	70	33.91299	101.93300	3408.0	9903.0	9968.0	Penn	2263.0	
Hall-019	62	34.36894	100.69508	2081.0	5015.0	5030.0	Penn	1799.0	
Hall-041s	78	34.33302	100.41923	1895.0	4814.0	4832.0	Penn	1535.0	
Hall-063s	72	34.55715	100.89093	2208.0	3365.0	3390.0	Wolf	1969.0	
Hall-063s	72	34.55715	100.89093	2208.0	3365.0	3390.0	Wolf	1757.0	
Lam-001	71	34.25360	102.57680	3741.0	8420.0	8587.0	Miss	2548.0	
Lam-024	65	33.99210	102.18140	3530.0	6265.0	6350.0	Wich	2528.0	
Lam-024	65	33.99210	102.18140	3530.0	8105.0	8128.0	Penn	2563.0	

HYDRAULIC HEAD DATA 1985

TEST HOLE	TEST DATE	LOCATION LAT	LOCATION LONG	SURFACE ELEV	INTERVAL TOP	INTERVAL BOTTOM	UNIT	WL ELEV msl	REFERENCE
Lam-116	70	33.85800	102.11510	3452.0	8385.0	8522.0	Penn	2614.0	BMI/ONWI-566
Lam-116	70	33.85800	102.11510	3452.0	8730.0	8845.0	Penn	2538.0	BMI/ONWI-566
Lam-134s	80	33.84642	102.31546	3465.0	6685.0	6743.0	Wolf	2352.0	
Lam-143s	77	33.83701	102.31520	3481.0	6680.0	6747.0	Wolf	2232.0	
Lam-143s	77	33.83701	102.31520	3481.0	7352.0	7404.0	Wolf	2528.0	
Lam-143s	77	33.83701	102.31520	3481.0	7748.0	7800.0	Wolf	2305.0	
Lam-143s	77	33.83701	102.31520	3481.0	7795.0	7873.0	Wolf	2656.0	
Lam-155s	80	33.96222	102.17224	3535.0	6456.0	6522.0	Wolf	2575.0	
Mot-001	57	34.23810	100.91769	2301.0	8014.0	8094.0	Penn	1470.0	
Mot-039	61	33.87570	100.92650	2757.0	4770.0	4790.0	Wolf	1739.0	
Mot-048	73	33.87421	100.68761	2237.0	5274.0	5356.0	Penn	1782.0	
Mot-048	73	33.87421	100.68761	2237.0	5248.0	5274.0	Penn	1755.0	
Mot-089s	62	33.89349	100.78900	2529.0	4248.0	4295.0	Wolf	81.0	
Mot-089s	62	33.89349	100.78900	2529.0	4345.0	4380.0	Wolf	1674.0	
Mot-094s	70	33.89661	100.78900	2536.0	4281.0	4331.0	Wolf	1378.0	
Old-004	61	35.59621	102.65120	3553.0	3446.0	3471.0	Wolf	1901.0	
Old-004	61	35.59621	102.65120	3553.0	3446.0	3471.0	Wolf	1865.0	
Old-048	69	35.40704	102.34653	3600.0	5340.0	5367.0	Wolf	1801.0	
Old-063	69	35.32053	102.37709	3905.0	7272.0	7312.0	Wolf	1579.0	
Old-103s	80	35.36581	102.35529	3709.0	6714.0	6735.0	Penn	2265.0	
Old-111s	80	35.25681	102.40025	3949.0	7120.0	7210.0	Penn	2348.0	
Old-111s	80	35.25681	102.40025	3949.0	8314.0	8348.0	Penn	2308.0	
Old-111s	80	35.25681	102.40025	3949.0	7646.0	7770.0	Penn	2153.0	
Old-111s	80	35.25681	102.40025	3949.0	7090.0	7202.0	Penn	2035.0	
Old-112s	80	35.19295	102.33081	3966.0	7318.0	7334.0	Penn	2222.0	
Old-112s	80	35.19295	102.33081	3966.0	7036.0	7145.0	Penn	1992.0	
Old-116s	81	35.36060	102.42160	3830.0	6172.0	6227.0	Wolf	2283.0	
Old-117s	81	35.33220	102.44275	3884.0	6630.0	6660.0	Penn	1785.0	
Old-118s	81	35.32747	102.22202	3544.0	7000.0	7028.0	Penn	1962.0	
Old-118s	81	35.32747	102.22202	3544.0	7125.0	7175.0	Penn	2288.0	
Old-121s	82	35.39750	102.39630	3687.0	4800.0	4996.0	Wolf	1840.0	
Old-121s	82	35.39750	102.39630	3687.0	4800.0	4996.0	Wolf	1771.0	
Old-121s	82	35.39750	102.39630	3687.0	6612.0	6640.0	Penn	2175.0	
Old-121s	82	35.39750	102.39630	3687.0	4812.0	4840.0	Wolf	2037.0	
Pot-026	64	35.42839	101.62508	3540.0	3600.0	3646.0	Wolf	81.0	
Pot-026	64	35.42839	101.62508	3540.0	3907.0	4050.0	Wolf	1408.0	
Pot-026	64	35.42839	101.62508	3540.0	5652.0	5710.0	Penn	1630.0	
Pot-039	64	35.24870	101.86406	3577.0	4047.0	4077.0	Wolf	1527.0	
Ran-048s	83	34.77700	101.85700	3624.0	1718.0	1764.0	Qu/G	3459.0	
Ran-048s	83	34.77700	101.85700	3624.0	1718.0	1764.0	Qu/G	3420.0	
Ran-x01	61	34.97224	102.14690	3777.0	5340.0	5361.0	Wolf	2003.0	
Swi-008	61	34.55617	101.90129	3591.0	5765.0	5796.0	Wolf	2300.0	
Swi-025s	82	34.53120	101.68000	3405.0	2927.0	2972.0	LSA4	3340.0	
Swi-025s	82	34.53120	101.68000	3405.0	2927.0	2972.0	LSA4	3363.0	
Swi-025s	82	34.53120	101.68000	3405.0	5365.0	5542.0	Wolf	2279.0	
Swi-025s	82	34.53120	101.68000	3405.0	5365.0	5542.0	Wolf	2238.0	
Swi-025s	82	34.53120	101.68000	3405.0	7146.0	7225.0	Penn	2124.0	
Swi-025s	82	34.53120	101.68000	3405.0	7146.0	7225.0	Penn	2026.0	
Swi-026s	82	34.65000	101.80900	3525.0	2840.0	2906.0	LSA4	3428.0	

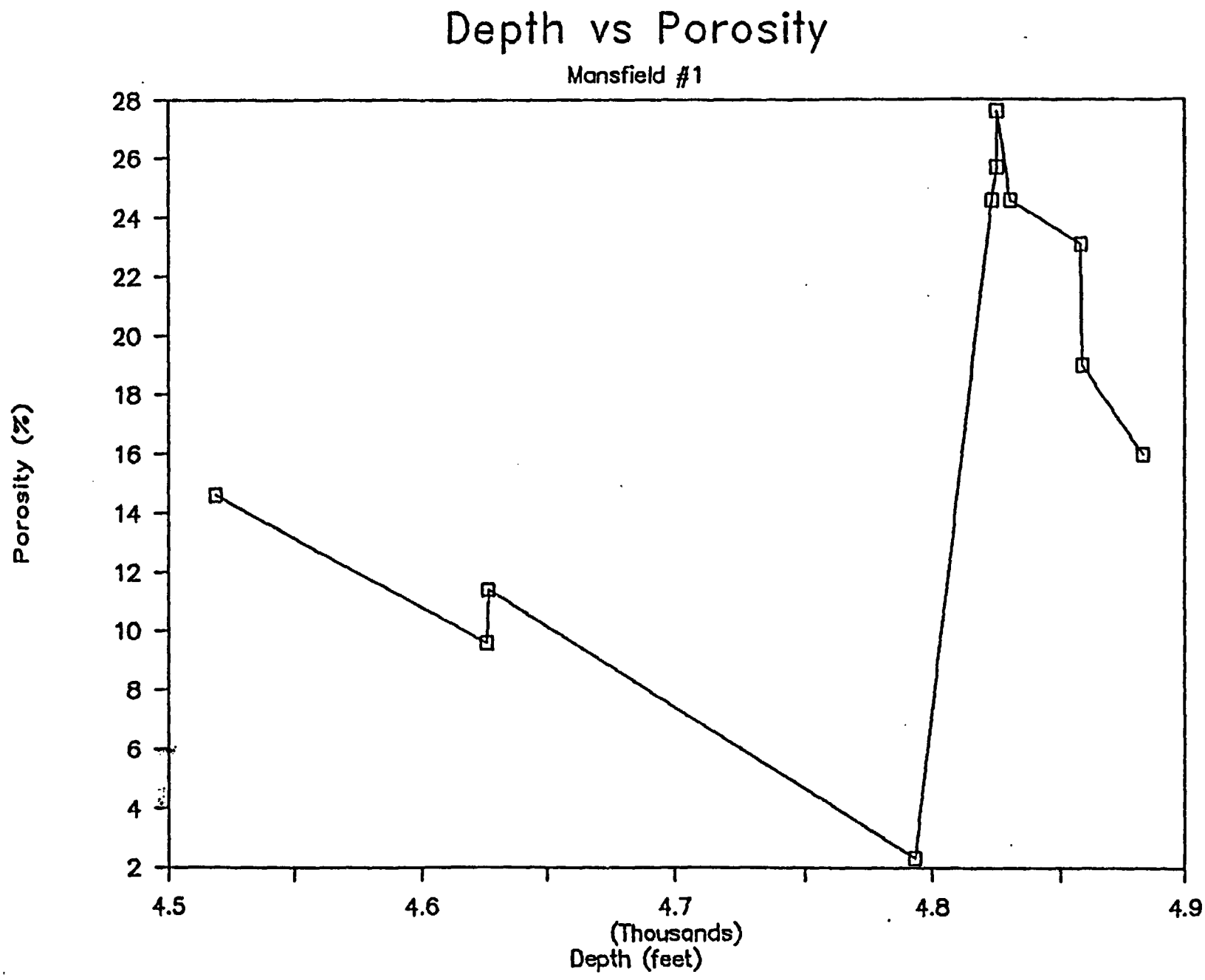
ATTACHMENT 3

HYDROLOGIC DATA

TEST TYPE	LOCATION	TEST INTERVAL TOP	TEST INTERVAL BOTTOM	UNIT	PERMEABILITY HORZ	PERMEABILITY VERT	HYD CONDUCTIVITY HORZ	HYD CONDUCTIVITY VERT	POROSITY	SPECIFIC STORAGE	TRANSMISSIVITY	REFERENCE	OTHER
Typical assigned values				Ogal-f			0.00	0.00		1.00E-04		OF-UTUI-1984-32	OF-UTUI-19
												Myers, 1969	OF-UTUI-19
				Tr-f/l			0.00	0.01		1.00E-04		OF-UTUI-1984-32	OF-UTUI-19
												Myers, 1969	
				Pere-sdz			8.20E-02	8.20E-04		1.00E-04		OF-UTUI-1984-32	
				Pere-sl			8.20E-05	8.20E-05		1.00E-04		OF-UTUI-1984-32	
												Freeze and Cherry, 1979	
				Pere-sab			3.20E-07	3.20E-07		1.00E-04		OF-UTUI-1984-32	
				Per/Pen-ch			1.30E-02	1.30E-04		1.00E-04		OF-UTUI-1984-32	
				Per/Pen-bas			1.10E-07	1.00E-07		1.00E-04		OF-UTUI-1984-32	
				Per/Pen-sil/at			8.20E-02	8.20E-04		1.00E-04		OF-UTUI-1984-32	
												Freeze and Cherry, 1979	
				Per/Pen-tan			1.00E-02	1.00E-04		1.00E-04		OF-UTUI-1984-32	
Drawdown	Sawyer #2	6.71		SA-SDZ			0.400				2.4	OF-UTUI-1985-3	
Type Curve							0.500				3.6		
Recovery		6.71					0.300				2.3		
Type Curve							0.600				3.7		
Drawdown 1	Mansfield #2	16.76		SA-SDZ									
Jacob approx													
Type Curve							0.190				3.2		
Recovery 1							0.190				3.2		
Theis approx													
Type Curve							0.160				2.7		
Drawdown 3							0.170				2.8		
Type Curve													
Jacob approx							0.160				2.7		
Drawdown 4							0.181				3		
Type Curve													
Jacob approx							0.090				1.5		
Recovery 4							1.89E-01				3.2		
Type Curve													
Theis approx							3.00E-01				5		
							1.90E-01				3.5		
Type Curve	Holtzclaw 1	14.04		Seven R			7.00E-03				0.1	OF-UTUI-1985-35	
Type Curve	Holtzclaw 1	14.04		Sal/Tan			6.00E-05				0.0008		
Cores-TUOB (70)													
OST (25)				Evap				2.00E-04					
Pumping Test (6)	Sawyer 1			Wolf	18.17	0.07			0.08				
					[17.99]	300.00			0.064				
									[.055]				
OST (25)	Sawyer 1			OB-Penn	17.81				0.08				
Cores-TUBO (118)					[41.68]				[.055]				
OST (10)	Sawyer 1				3.56				0.23				
Pumping Test (10)					[478.19]				[.12]				
Cores-TUOB (11)													
Cores-Mobestie (415)													
OST (11)	Sawyer 1			Pre-Penn	4.76								
Pumping Test (14)					[17.64]								

HYDROLOGIC DATA

TEST TYPE	LOCATION	TEST DEPTH TOP	TEST DEPTH BOTTOM	UNIT	PERMEABILITY HORZ	PERMEABILITY VERT	HYD CONDUCTIVITY HORZ	HYD CONDUCTIVITY VERT	POROSITY	SPECIFIC STORAGE	REFERENCE	OTHER
CORE	JFR#1	8168	8204	PENN	44.7						OF-UIUI-1984-27,42	
CORE	JFR#1	8122	8132	PENN	122.3						OF-UIUI-1984-27,42	
CORE	JFR#1	8040	8050	PENN	148.7						OF-UIUI-1984-27,42	
CORE	JFR#1	7896	7904	PENN	40.2						OF-UIUI-1984-27,42	
CORE	JFR#1	7707	7711	PENN	254.3						OF-UIUI-1984-27,42	
CORE	JFR#1	7300	7326	PENN	89.1						OF-UIUI-1984-27,42	
CORE	JFR#1	5825	5926	WOLF	0.89						OF-UIUI-1984-27,42	
DST	JFR#1	5630	5909	WOLF	1.1						OF-UIUI-1984-27,42	
CORE	MAN#1	4519.1				0.076			14.6		OF-UIUI-1984-27	
CORE	MAN#1	4625.8			0.36				9.6		OF-UIUI-1984-27	
CORE	MAN#1	4626.4				0.46			11.4		OF-UIUI-1984-27	
CORE	MAN#1	4793							2.3		OF-UIUI-1984-27	
CORE	MAN#1	4823.4			0.86				26.6		OF-UIUI-1984-27	
CORE	MAN#1	4825.2				1.1			25.7		OF-UIUI-1984-27	
CORE	MAN#1	4825.3			0.36				27.6		OF-UIUI-1984-27	
CORE	MAN#1	4830.5			0.7				24.6		OF-UIUI-1984-27	
CORE	MAN#1	4858.3			20				23.1		OF-UIUI-1984-27	
CORE	MAN#1	4859.1				6.5			19		OF-UIUI-1984-27	
CORE	MAN#1	4883.4			2.8				16		OF-UIUI-1984-27	
CORE	SAW#1	2987.1							6.6		OF-UIUI-1984-27	
CORE	SAW#1	3015.2			6.7				17.8		OF-UIUI-1984-27	
CORE	SAW#1	3015.4				0.066			22.6		OF-UIUI-1984-27	
CORE	SAW#1	3054.8							5		OF-UIUI-1984-27	
CORE	SAW#1	3083			0.031				13.5		OF-UIUI-1984-27	
CORE	SAW#1	3109.7							5.1		OF-UIUI-1984-27	
CORE	SAW#1	3110							4.1		OF-UIUI-1984-27	
CORE	SAW#1	3147.1			0.3				17.8		OF-UIUI-1984-27	
CORE	SAW#1	3173.3							2.7		OF-UIUI-1984-27	
CORE	SAW#1	3173.5							8.9		OF-UIUI-1984-27	
CORE	SAW#1	3185.8			1.1				20.7		OF-UIUI-1984-27	
CORE	SAW#1	3186.1				0.34			19.9		OF-UIUI-1984-27	
CORE	SAW#1	3205.8							7.3		OF-UIUI-1984-27	
CORE	SAW#1	3219.4			1.5				12.1		OF-UIUI-1984-27	
CORE	SAW#1	3274.3							4.7		OF-UIUI-1984-27	
CORE	SAW#1	3276.4							3.4		OF-UIUI-1984-27	
CORE	SAW#1	3392.7			30				19.1		OF-UIUI-1984-27	
CORE	SAW#1	3393.7			0.013				19.3		OF-UIUI-1984-27	
CORE	SAW#1	3484.2			26				18.1		OF-UIUI-1984-27	
CORE	SAW#1	3491.3			1.3				20.2		OF-UIUI-1984-27	
CORE	SAW#1	3549.4			0.11				7.9		OF-UIUI-1984-27	
CORE	SAW#1	3688.9			<0.01				12.6		OF-UIUI-1984-27	
CORE	SAW#1	3712.6				0.043			15.1		OF-UIUI-1984-27	
CORE	SAW#1	3712.7			0.12				13		OF-UIUI-1984-27	
CORE	SAW#1	3716.5			<0.01				10.9		OF-UIUI-1984-27	


Depth vs Porosity
Mansfield #1
Porosity (%)
28
26
24
22
20
18
16
14
12
10
8
6
4
2
4.5
4.6
4.7
4.8
4.9
(Thousands)
Depth (feet)

HYDROLOGIC DATA

TEST TYPE	LOCATION LAT	LOCATION LONG	TEST DEPTH TOP	TEST DEPTH BOTTOM	UNIT	PERMEABILITY HORZ	PERMEABILITY VERT	POROSITY	RATING	COMMENTS
CORE	MAN#1		4519.1				0.094	14.6		DOLOMITE
CORE	MAN#1		4625.8			0.36		9.6		DOLOMITE
CORE	MAN#1		4626.4				0.46	11.4		DOLOMITE
CORE	MAN#1		4793					2.3		LIMESTONE
CORE	MAN#1		4823.4			0.86		24.6		LIMESTONE
CORE	MAN#1		4825.2				1.1	25.7		LIMESTONE
CORE	MAN#1		4825.3			0.36		27.6		LIMESTONE
CORE	MAN#1		4830.5			0.7		24.6		LIMESTONE
CORE	MAN#1		4858.3			20		23.1		LIMESTONE
CORE	MAN#1		4859.1				6.5	19		LIMESTONE
CORE	MAN#1		4883.4			2.8		16		LIMESTONE

Depth vs Porosity

Regression Output:

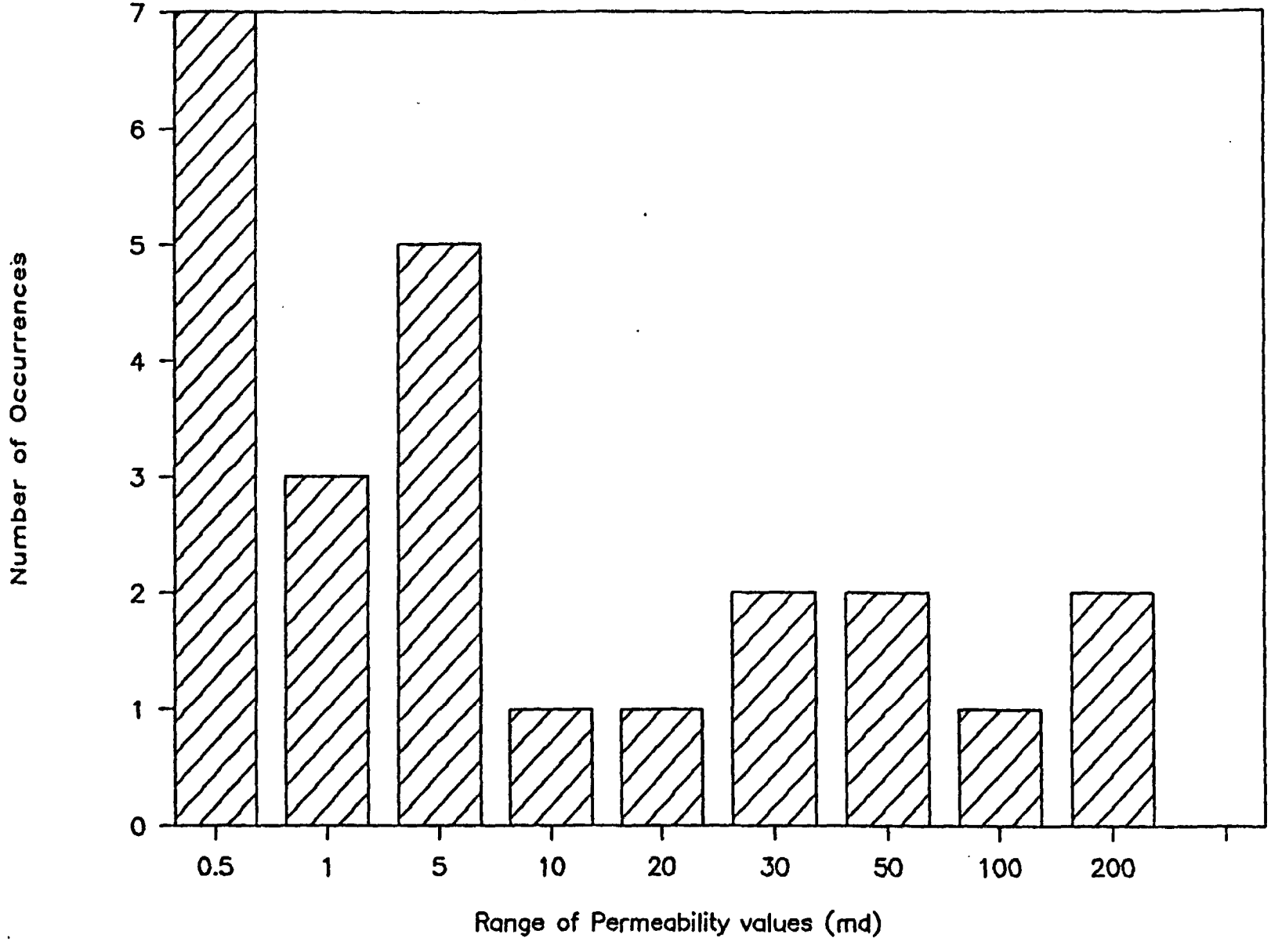
Constant	-134.4593
Std Err of Y Est	7.3965178
R Squared	0.2327327
No. of Observations	11
Degrees of Freedom	9
X Coefficient(s)	0.0319719
Std Err of Coef.	0.0193505

Frequency Distribution for Permeability

Range	Frequency
0 - 0.5	7
.5 - 1	3
1 - 5	5
5 - 10	1
10 - 20	1
20 - 30	2
30 - 50	2
50 - 100	1
100 - 200	2
200 +	0

Frequency Distribution for Permeability

Sawyer #1, Mansfield #1: 3,000–5,000 ft



ATTACHMENT 4

HYDROCHEMISTRY DATA

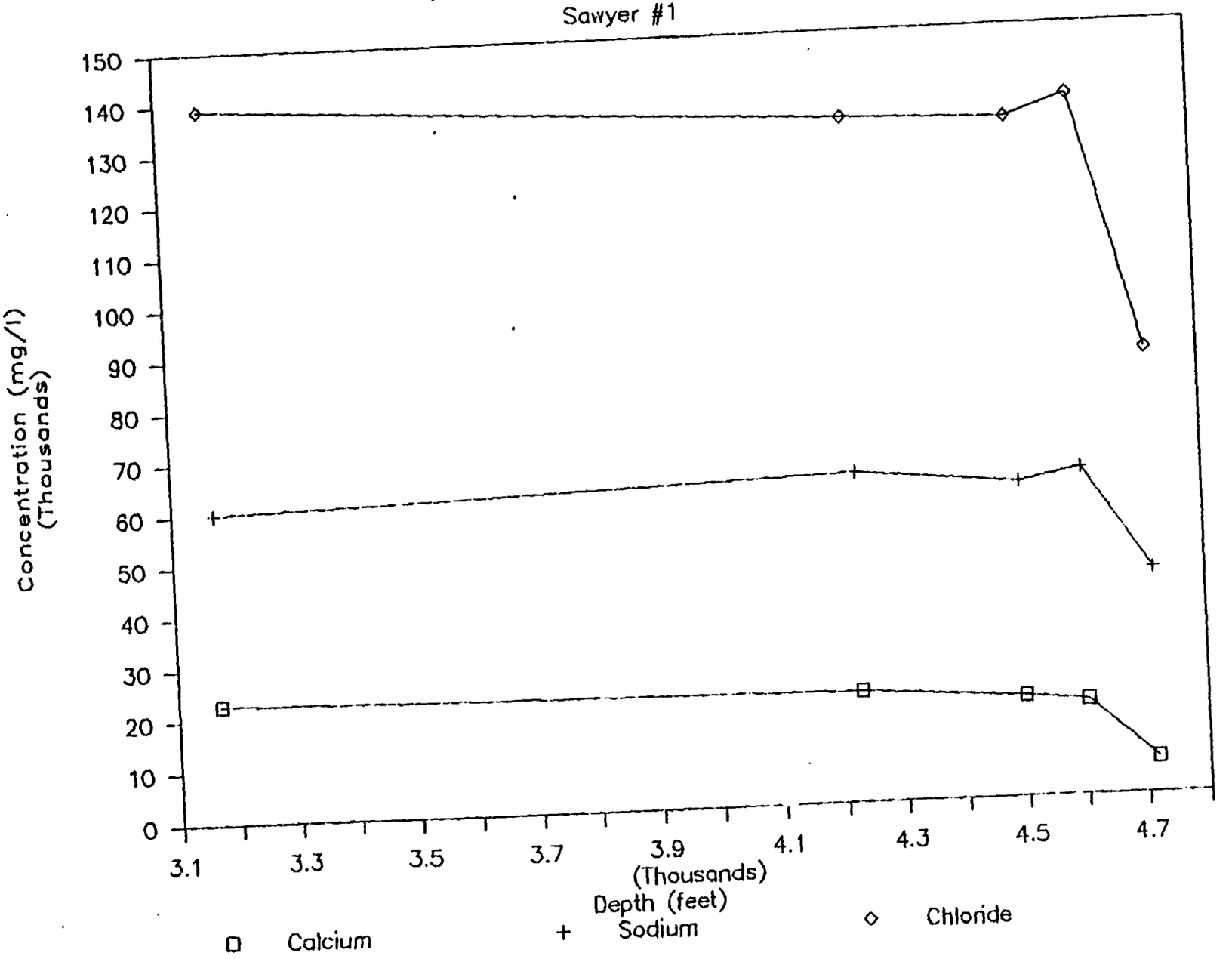
TEST HOLE	TEST INTERVAL TOP	TEST INTERVAL BOTTOM	UNIT	DATE	MEAS TYPE	TEMP	COND	pH	Eh	TDS	MAJOR CATIONS Ca	K	Mg	Na	SiO2	MAJOR ANIONS Cl	F	HCO3	CO3	SO4	OH	TRACE METALS As	Ba	Br	??	??	ISOTOPES d0-18	dD	dC-13	dS-34	REFERENCE
Sawyer 1	4716		Elburg			39		5.35			22900	459	2400	60200		139000		296		169							-1.73	-27	5.14		OF-UTUI-1984-52
Sawyer 1	4604		Elburg			39		7.5			21600	420	2010	64000		133000		271		230							-0.83	-13	-2.25		
Sawyer 1	4500		Miss-Ls			39		5.4			19400	337	2310	61000		132000		227		237							-0.61	-10	3.42	12.86	
Sawyer 1	4220		Gran Wash			39		4.4			18300	332	2180	63400		136000		237		336							-1.19	-15	8.12	13.77	
Sawyer 1	3172		Wolf			35		6.1			6760	110	2490	43450		86300		144		2010							0.72	-23	1.83	10.37	
Mansfield	4810		Wolf			30		5.6			5960	349	1320	78400		138000		131		1220							-5.70	-43	2.63	17.35	
Mansfield	4514		Wolf			41		4.0			6020	300	1600	76100		131000		161		1320							-5.12	-42	1.83	16.6	
Zeeck 1	7140		Penn-Ch			54		5.8			11950	197	1550	76350		151500		31		81							0.73	-16	3.31	12.50	
Zeeck 1	5603		Wolf			30		6.9			6760	314	1290	61700		105000		113		977							0.0	-23			
Zeeck 1	5474		Wolf			41		6.25			6210	339	1820	69300		120000		94		1650							2.17	-23	2.74	13.3	
Friesel 1	8160		Gran Wash			55		5.9			15700	620	2110	77930		140500		35		440							-2.80	-20		9.76	
Friesel 1	8122		Gran Wash			55		5.9			15400	610	2130	78230		140100		69		487							-3.53	-35	-6.82	9.77	
Friesel 1	8040		Gran Wash			55		6			15050	636	2100	77300		147420		71		492							-3.46	-34	-4.51	9.86	
Friesel 1	7895		Gran Wash			55		6.2			17120	570	2560	77670		154900		21		519									-6.65	10.12	
Friesel 1	7707		Gran Wash			53		5.2			19330	551	3020	87560		170500		43		370							-2.83	-10	-5.7	14.7	
Friesel 1	7300		Penn-Ch			52		6.6			12790	530	2560	78460		150000		73		631							-2.7	-31	2.4	13.9	
Friesel 1	5625		Wolf			30		6.2			8370	509	2160	72470		129770		205		1373							-3.7	-34	3	14.5	
Sawyer 1	0		Gran Wash								19200	360	2560	57200		140000				400											Draft Envir Assess D
Mansfield 1			Wolf								9000	530	1900	79000		130000				1240											
Zeeck 1			Penn-Ch								12500	207	2100	74900		155000				200											
Zeeck 1			Wolf								7000	400	2000	71000		120000															
Friesel 1			Gran Wash								16000	630	2400	74000		150000				430											
Friesel 1			Penn-Ch								12000	590	2300	77000		150000				540											
Sawyer 2			L San Andres					6.3	-0.19	94924	1860	30.3	480	33000		54700		72.6		4725				21.4							
Mansfield 2			Seven Rivers					7.35	-0.33	67537	1440	31.9	300	23950		36120		41.53		5610				6.2			-7.3	-47.7	-1.9	11.92	OF-UTUI-1985-3
																											-9.2	-40.5	-3.1	9.87	
Hall-1	Spring					8		7.5			1010	22	304	5230		8250		196		3350											OF-UTUI-1983-4
Hall-3a						53		8			1835	57.2	341	23166		32225		124		4805				6.3			-4.7				
Hall-3b								6.6			1350	78	548	13100		20600		100		4520											
Hall-3c								6.8			905	35	1156	8775		13200		400		6700											
Child-4a						71		7.52			1440	35	295	25100		38975		111		4750				9.78							
Child-4a						60		7.3			1304	28.7	245	14730		23400		150		4000				5.96							
-5								7.6			1030		213	5970		9500		110		2860											
Cattle-8						76		8.55			1050	10.9	230	7630		11860		97		3450				3.3							
Cattle-9a						70		8.17			1270	19.3	194	12340		19320		104		3940				6.08							
Cattle-9b						75		8.1			1270	19	223	13860		21624		121		3960				6.72			-4.97	-40			
Cattle-9c						72		7.5			1250	18.7	170	11600		18257		121		3750				5.53			-5.83	-41			
Cattle-10a						71		7.31			1230	22.1	243	12430		19497		130		3960				6.17			-5.9	-45			
Cattle-11a						65		7.4			1165	30.5	230	9770		14210		130		3431				4							
Cattle-11b						63		7.3			979	16.8	196	7380		11445		170		3160				6.43							
Cattle-11c						70		7.4			782	11	154	3910		6253		164		2410				2.39			-5.56	-39			
Cattle-11d						70		7.51			740	10	149	3350		5384		173		2150				2.11			-5.64	-40			
Kent-17						70		7.3			1750	87.9	400	39900		63000		43		5540				11			-6.11	-49			
Kent-18						70		6.9			467	281	1200	103000		150000		27		6710				26.8			-5.79	-44			
Child-19	49.3	100.3				70		8.4			1380	36.4	290	12740		19450		175		4050				7.5							
-20	127	132.5				60		8.1			1450	46.2	340	23890		37400		114		4810				13							
-21	150	224.8									2430	114	154	44550		68400		0		5220				17.3							
-22	22.1	44.5									1700	34.9	397	20640		32720				4710				9.3							
-23	145	185									1910	55.6	542	34850		55960				5220				13.7							

HYDROCHEMISTRY DATA

TEST HOLE	TEST INTERVAL TOP	TEST INTERVAL BOTTOM	UNIT	DATE	MEAS TYPE	TEMP	COND	pH	Eh	TDS	MAJOR CATIONS Ca	K	Mg	Na	SiO2	MAJOR ANIONS Cl	F	HCO3	CO3	SO4	OH	TRACE METALS As	Ba	Br	??	??	ISOTOPES d0-18	d0	dC-13	d5-34	REFERENCE
-24	32	47.8									1570	35.3	372	16970		27550				4500				7.7							
-25	116	135									1310	33.2	303	13368		21400				4110				5.5							
-26	20	20.3			#						1660	39.5	390	21420		34460				5010				9.3							
Cattle-27	86	173			64.5		7.5				1291	26.5	255	10541		16000		165		3650				6.5			-4.74				
-28	103.1	151.5			64		7.8				1292	20.6	249	10439		16000		127		4040				7							
-29	Spring										1550	25	322	15010		23400				4440				6.8							
-30	49.8	52.8									1300	23.4	272	11010		17190				3990				5.7							
Kent 31	173	400			71		6.9				1496	72.7	349	20476		32000		66.5		4073				5.7							
-32	307	357			70.5		6.7				1294	153.8	421	52590		79970		58		5084				13.1							
-33	8	175			70		6.1				769	169.2	428	91044		135820		32		6837				19.6							
-34	46	53					6				913	91	415	55400		84470		39		5397				17.5							
-35	519.5	602					5.6				1382	183	522	122604		189916		26		4375				21.6							
-36		100					6.1				1343	280	1390	98952		151962		46		6938				21.2							
-37		300					6				1020	264	521	116420		179694		43		6344				35							
-38	100	400			71		6.6				1225	283	1048	111085		168454		68		6632				25.9							
-39	2	190			71		6.7				1669	290	466	82525		129168		86		6252				27.4							
-40	8	93			71		7				1626	104	996	38734		60027		46		5575				11.8							
-41		360					6.4				1393	209	1469	74687		115342		54		7617				19.4							
-42	#	460					5.9				982	225	843	118244		185000		48		1918				9.3							
-43	401.5	525			68		6.6				1283	285	265	103460		158895		96		6391				27.1							
-44		500			70		6.3				1079	95	288	122800		187824		32.5		5659				11.9							
-45	426	603			71		6.2				1439	79.8	398	73060		113524		77		4139				10							
-46	260	410			71		5.6				2136	158	480	121200		187530		12		2964				48							
-47		304			70		6.3				2171	144	1163	114050		182530		15		3257											
-48	206	299			65		5.9				925	1794		124836		192708		38		7211				26.7							
Mountainair		215	Yeso																								-11.5	-82			
Santa Rosa 3		620	San Andres																								-10.9	-82			
Santa Rosa		42	Alluvium																								-7.3	-55			
Fort Sumner		201	Artesia Gr																								-7.52	-57			
Tucumcari 12		330	Dockum																								-6.96	-50			
-18		318	Dockum																								-6.89	-47			
Clovis 29		360	Ogallala																								-7.04	-52			
Friona 9		318	Ogallala																								-8.01	-56			
Dimmitt 1		375	Ogallala																								-6.95	-52			
Tulia 14		816	Dockum																								-9.22	-68			
Kress		300	Ogallala																								-5.49	-44			
Silverton		200	Ogallala																								-5.63	-41			
Turkey		174	Perm/Alluv																								-6.42	-44			
Estelline		42	Perm/Alluv																								-5.36	-42			
India Creek		20	Perm/Alluv																								-6.33	-46			
Paducah		240	Perm/Alluv																								-6.16	-41			
Tulia 14		816	Dockum																								-10				
-7		?200	Ogallala																								-7.8				
Silverton		181	Ogallala																								-5.3				
Plainview 14		325	Ogallala																								-8.6				
Floyada		312	Ogallala																								-7.6				
Quitaque		192	Perm/Alluv																								-6.5				
		?	Perm/Alluv																								-6.8				
Turkey		118	Perm/Alluv																								-5.3				
Floyd		?	Perm/Alluv																								-6.1				
Matador		273	Perm/Alluv																								-6				

Comparison of Ca, Na, Cl

Sawyer #1



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Nuclear Waste Consultants

RE: BWIP Document Review - RHO-BW-CR-150 P

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ATTACHMENT 6

INFORMAL DOCUMENT REVIEWS - FAMILIARIZATION

Document: OF-WTWI-1983-4, "Identification of Recharge-Discharge Areas of the Palo Duro Basin, Texas Panhandle', 1983, R.K. Senger and B.C. Richter.

Reviewer: F.M. Phillips

Date Reviewed: 6 December 1985

Summary and Comments: Use of isotopic (D/H and O/ O) plus geochemical (Br/Cl and Na/Cl ratios) evidence to identify sources of saline discharge in Texas Panhandle. Very well done study, classic use of isotopic/geochemical methods to identify sources of natural waters very similar in bulk composition. Most salt seeps are from evaporite aquitard dissolution, but a few are deep basin brine discharge. "Hydrochemical and Isotope Hydrology Results for the Palo Duro Basin...Material presented at the June 5, 1984 Discussion Meeting, Columbus, Ohio" Norm Hubbard.

Interesting hodge-podge of material. Noble-gas results by far the most interesting. According to authors, both stable and radiogenic noble gas concentrations support a true connate origin for the deepest brines (i.e., contemporeneous with salt disposition!). The work appears reasonably well done, but much more support is needed. I want to see all of the noble-gas data. What about D/H and O/ O origins? Reread this one.