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September 7, 1994

Mr. Gene McLoughlin, P.E.
MDWASA
P.O. Box 330316
Miami, Florida 33233-0316

Dear Mr. McLoughlin,

The purpose of this letter report is to describe the procedures used and the results obtained from quantitative hydraulic analysis of a potential monitoring zone within the Floridan Aquifer system penetrated by Injection well I-17. The straddle packer test and subsequent hydraulic analysis were conducted in the zone of the aquifer between 1580 and 1610 feet below land surface (BLS).

METHOD

A straddle packer was used to isolate the test zone for drawdown and recovery tests. The formation tested is under artesian pressure, and was allowed to flow at a rate of 65 gpm during the drawdown portion of the test. Water level changes were measured in the drill stem with a pressure transducer and recorded on a Hermit 1000-C data logger. Prior to testing, the well was developed by pumping the formation fluid until the specific conductance stabilized. Specific conductance readings taken during the test are included in Appendix I. The well was then allowed to recover from development before performing the test.

BACKGROUND

A 17 inch pilot hole was drilled below casing to a depth of 1900 feet below land surface. A suite of geophysical logs were run and, together with the borehole cutting samples, the test zone was selected by the WASA project hydrogeologist. The zone was selected between 1580-1610 feet below land surface. The zone was isolated with an inflatable 30 foot straddle packer with 10 feet of perforated pipe, open to the formation, between the two packer elements.

The packer assembly was lowered on the drill stem into the original pilot hole to the tested interval of 1580-1610 feet B.L.S. The packer elements were then inflated. After more than 8 hours of artesian flow, a constant specific conductance of 9,000 umhos was reached. The well was allowed to recover to its initial antecedent conditions. After recovery, the well was allowed to flow for 1 hour while drawdown data was recorded. Recovery data were then recorded until the formation water level had again reached antecedent conditions. Background, drawdown and recovery water level data is graphed on Figure 1. The test was run at a flow rate of 65 gpm, and is analyzed as follows. Raw data are presented in Appendix II.

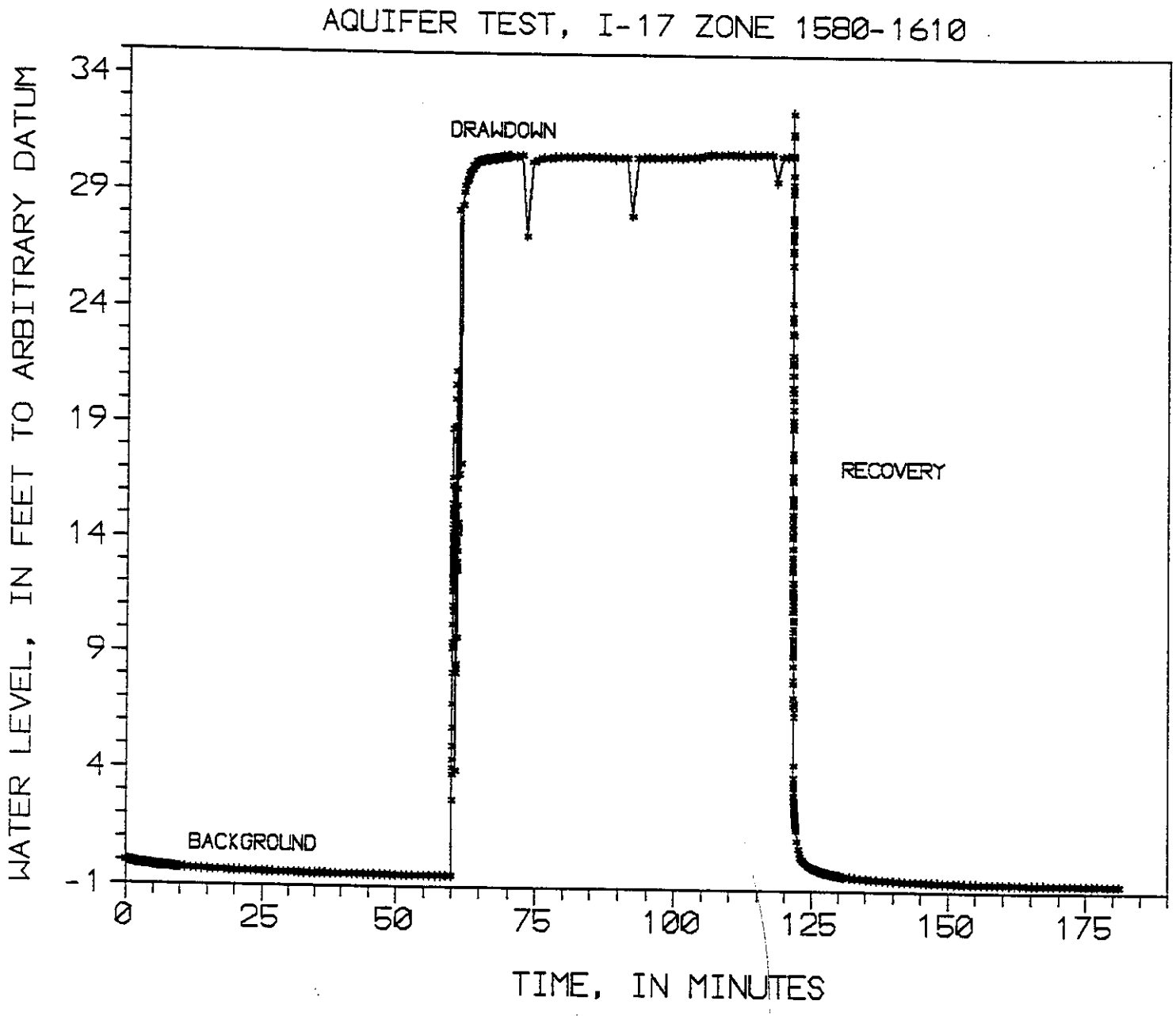


Figure 1.-- Background, drawdown and recovery water level data from I-17, zone 1580 to 1610.

DATA ANALYSIS

Three methods of data analysis were tested for this zone.

1. Cooper-Jacob Analysis
2. Theis Analysis (Leaky)
3. Theis recovery analysis

1. Cooper-Jacob Analysis

The Cooper-Jacob method of analysis was not conducted due to large amounts of surging in the well during the free flow drawdown portion of the test (see Figure 2).

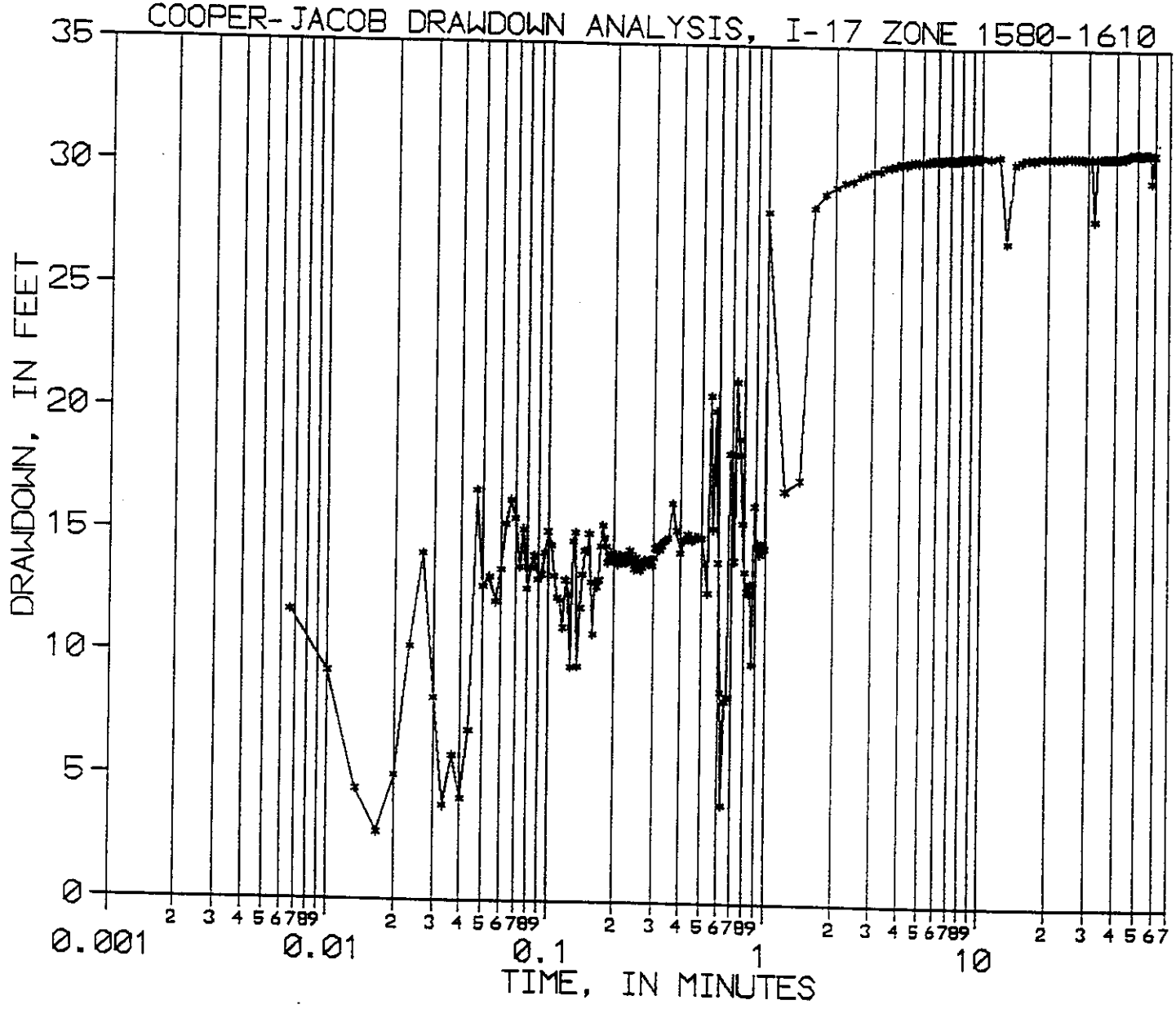


Figure 2.-- Cooper-Jacob Drawdown Analysis I-17, zone 1580 to 1610

2. Theis Analysis

The time-drawdown data for the packer test was analyzed using the Theis nonequilibrium equation given by (Todd, 1980, 123) as:

$$s = \frac{(Q)\ (W(u))}{(4)\ (\pi)\ (T)}$$

Where s is the drawdown, Q is the pumping rate and T is the transmissivity.

W (u) is the well function and (u is the exponential integral function) where

$$u = \frac{(r^2) \cdot (S)}{(4)\ (\pi)\ (T)\ (t)}$$

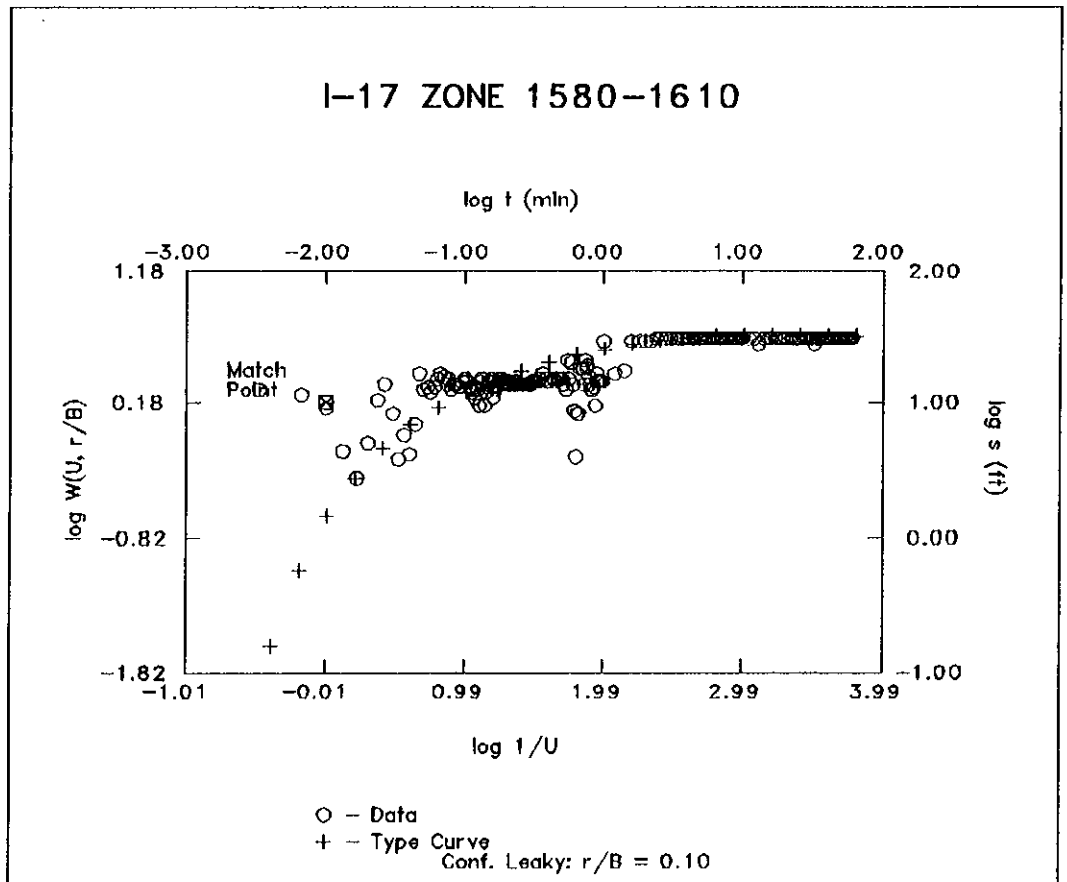
Where r is the distance to the observation well (r = well radius for a single well test).

S = Storage coefficient

t = Time since the start of pumping

Transmissivity and storage coefficient values were determined from the drawdown data by type - curve matching techniques as described in Todd (P125-128) and by using the computer package GWAP (Graphical Well Analysis Package). Figure 3 shows the type curve superimposed on the drawdown data plot and the resulting computed values for transmissivity, hydraulic conductivity and storativity (Storage coefficient divided by unit thickness). Values for horizontal hydraulic conductivity expressed in standard units are:

K = 37.6 gal/day/sq.ft.
K = 1.8 X 10^{-3} cm/sec



MATCH POINT			SOLUTION		
t	=	1.000E-0002	Transmissivity (T)	=	1.127E+0003 gpd/ft
s	=	1.000E+0001	Hydraulic Conductivity (K)	=	3.757E+0001 gpd/sq ft
1/U	=	9.772E-0001	Storativity (S)	=	8.546E-0003
W(U, r/B)	=	1.514E+0000	Leakage Factor (B)	=	7.080E+0000 ft

WELL INFORMATION	
WELL IDENTIFICATION	: I-17 158
DATE OF AQUIFER TEST	: 7/31/94
AQUIFER THICKNESS (b)	: 3.000E+0001 ft
DISCHARGE RATE (Q)	: 6.500E+0001 gpm
PUMPING WELL RADIUS (r)	: 7.080E-0001 ft
DISTANCE OF OBSERVATION WELL FROM PUMPING WELL (d)	: 7.080E-0001 ft

Figure 3.--Theis Leaky Curve Analysis I-17, zone 1580 to 1610

3. Theis Recovery Analysis

The Theis Method was used to analyze recovery in the well after the flow was stopped by shutting in the well, using the method as described in Todd (1980 p. 133). Residual drawdown, s′, was plotted against the log of the ratio of time from the start of flow to the time of shut down (t/t') (see Figure 4).

A straight line was fitted to the early time data and the change in residual drawdown over a single log cycle (s′) was calculated. Transmissivity was then determined from the equation: Todd (1980, p.134):

$$T = -\frac{(2.30)\ (12512.5)\ ft^3/day}{(4)\ (3.1416)\ (25.5\ ft)}$$

$$T = 89.8\ ft^2/day$$

Horizontal hydraulic conductivity is calculated by dividing T by the unit thickness of 30.0 ft.

$$K = 3.0 \times 10^{-1}\ ft/day$$
$$K = 1.1 \times 10^{-3}\ cm/sec$$

Analytical results of the tests are summarized as follows:

Hydraulic Conductivity

Theis	=	1.8×10^{-3} cm/sec
Theis Recovery Analysis	=	1.1×10^{-3} cm/sec

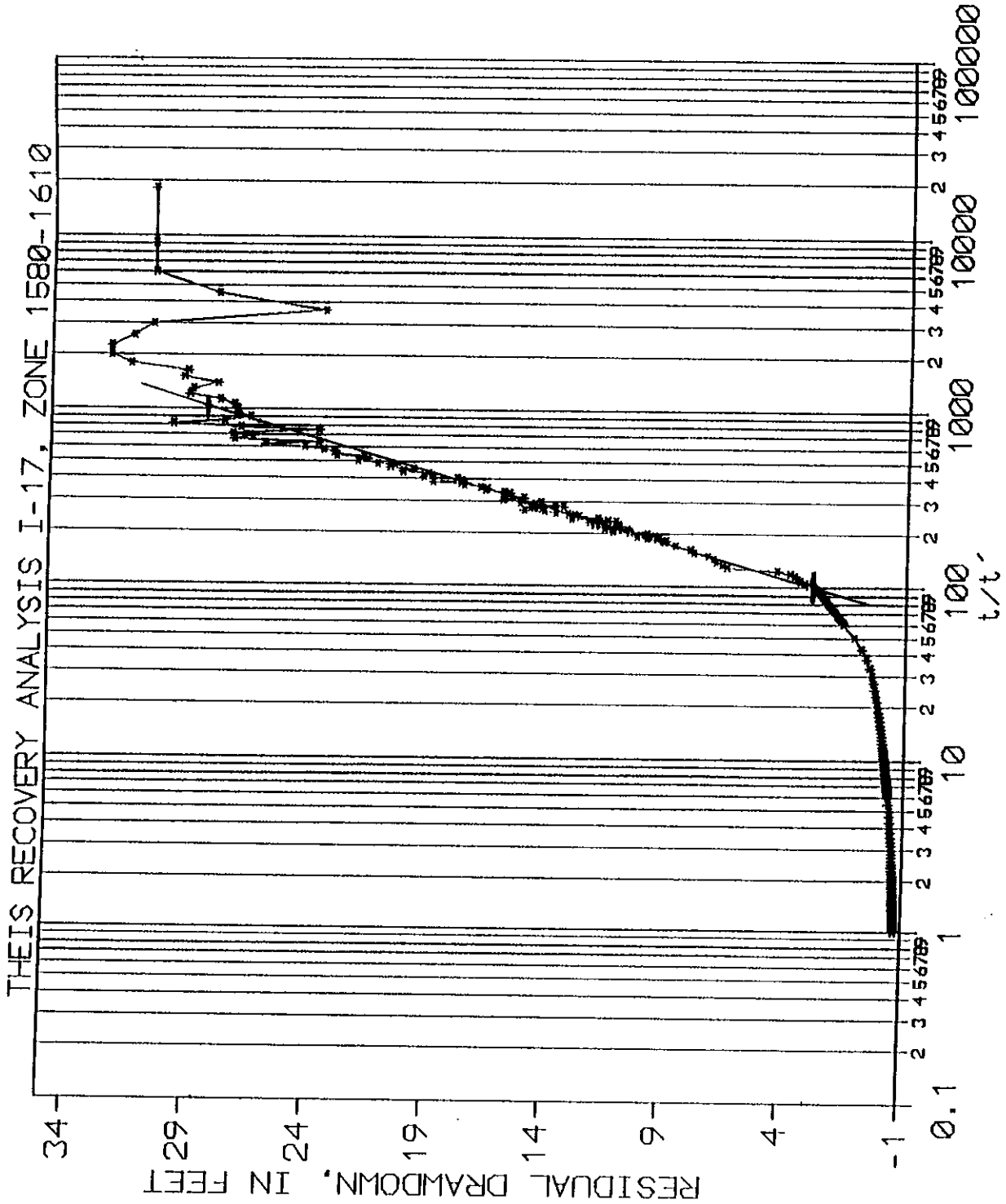


Figure 4.-- Theis Recovery Analysis I-17, zone 1580 to 1610

If you have any questions or comments please feel free to contact me or Leo Swayze.

Sincerely,

Edmand B. Workman, P.G.

EBW:na

#1450
5/7/54

Appendix I
Specific Conductance Stabilization Data

Packer Test (I-17)
Zone 1580-1610

TIME	TEMP °C	SALINITY	CONDUCTIVITY umhos
2400	26.5	12	.20
0030	26.5	11	.19
0230	25.5	7	.12
0300	25.5	7	.12
0330	25.5	6	.11
0400	25	6	.10
0430	25	6	.10
0500	25	6	.10
0530	25	6	.10
0600	25	5.5	.09
0630	24.5	5.5	.09
0700	24.5	5.5	.09
9:15	26	9.0	.1
9:30	26.5	8.5	.09
9:45	26.5	9.0	.09
10:00	27	8.7	.09
10:15	26	9.0	.09

Appendix II
Raw Aquifer Test Data

SE1000C
Environmental Logger
08/31 12:44

Unit# 01513 Test 0

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.280
Scale factor	29.990
Offset	0.120
Delay mSEC	50.000

Step 0 08/31 07:14:19

Elapsed Time	INPUT 1
0.0000	-0.019
0.0033	-0.009
0.0066	0.000
0.0100	-0.009
0.0133	-0.009
0.0166	-0.009
0.0200	-0.009
0.0233	-0.019
0.0266	-0.009
0.0300	0.000
0.0333	-0.019
0.0366	-0.009
0.0400	-0.019
0.0433	-0.019
0.0466	-0.009
0.0500	0.000
0.0533	-0.019
0.0566	-0.019
0.0600	-0.009
0.0633	-0.009
0.0666	-0.009
0.0700	-0.009
0.0733	-0.019
0.0766	-0.019
0.0800	-0.009
0.0833	-0.009
0.0866	-0.019
0.0900	-0.009
0.0933	-0.019
0.0966	-0.009
0.1000	-0.009
0.1033	-0.019
0.1066	-0.009
0.1100	-0.019
0.1133	-0.009
0.1166	-0.019
0.1200	-0.019

0.1233	-0.019
0.1266	-0.009
0.1300	-0.009
0.1333	-0.019
0.1366	-0.019
0.1400	-0.009
0.1433	-0.009
0.1466	-0.019
0.1500	-0.019
0.1533	-0.019
0.1566	-0.009
0.1600	-0.009
0.1633	-0.019
0.1666	-0.019
0.1700	-0.019
0.1733	-0.019
0.1766	-0.009
0.1800	-0.009
0.1833	-0.019
0.1866	-0.019
0.1900	-0.009
0.1933	-0.009
0.1966	-0.019
0.2000	-0.019
0.2033	-0.019
0.2066	-0.009
0.2100	-0.019
0.2133	-0.019
0.2166	-0.019
0.2200	-0.009
0.2233	-0.019
0.2266	-0.019
0.2300	-0.019
0.2333	-0.019
0.2366	-0.019
0.2400	-0.019
0.2433	-0.019
0.2466	-0.019
0.2500	-0.019
0.2533	-0.019
0.2566	-0.019
0.2600	-0.019
0.2633	-0.019
0.2666	-0.019
0.2700	-0.009
0.2733	-0.028
0.2766	-0.019
0.2800	-0.019
0.2833	-0.019
0.2866	-0.028
0.2900	-0.019
0.2933	-0.028
0.2966	-0.009
0.3000	-0.019
0.3033	-0.019
0.3066	-0.019
0.3100	-0.019
0.3133	-0.019
0.3166	-0.019
0.3200	-0.019

0.3233	-0.019
0.3266	-0.019
0.3300	-0.028
0.3333	-0.019
0.3500	-0.019
0.3666	-0.019
0.3833	-0.028
0.4000	-0.019
0.4166	-0.028
0.4333	-0.019
0.4500	-0.028
0.4666	-0.028
0.4833	-0.028
0.5000	-0.028
0.5166	-0.038
0.5333	-0.038
0.5500	-0.028
0.5666	-0.028
0.5833	-0.038
0.6000	-0.038
0.6166	-0.028
0.6333	-0.028
0.6500	-0.038
0.6666	-0.038
0.6833	-0.038
0.7000	-0.038
0.7166	-0.038
0.7333	-0.038
0.7500	-0.047
0.7666	-0.038
0.7833	-0.038
0.8000	-0.047
0.8166	-0.038
0.8333	-0.038
0.8500	-0.047
0.8666	-0.047
0.8833	-0.047
0.9000	-0.047
0.9166	-0.038
0.9333	-0.047
0.9500	-0.047
0.9666	-0.047
0.9833	-0.057
1.0000	-0.047
1.2000	-0.057
1.4000	-0.076
1.6000	-0.086
1.8000	-0.086
2.0000	-0.095
2.2000	-0.095
2.4000	-0.105
2.6000	-0.114
2.8000	-0.124
3.0000	-0.124
3.2000	-0.133
3.4000	-0.133
3.6000	-0.143
3.8000	-0.152
4.0000	-0.152
4.2000	-0.162

4.4000	-0.162
4.6000	-0.171
4.8000	-0.171
5.0000	-0.181
5.2000	-0.191
5.4000	-0.191
5.6000	-0.200
5.8000	-0.200
6.0000	-0.200
6.2000	-0.210
6.4000	-0.210
6.6000	-0.219
6.8000	-0.210
7.0000	-0.229
7.2000	-0.229
7.4000	-0.238
7.6000	-0.238
7.8000	-0.238
8.0000	-0.238
8.2000	-0.248
8.4000	-0.248
8.6000	-0.248
8.8000	-0.248
9.0000	-0.257
9.2000	-0.267
9.4000	-0.267
9.6000	-0.267
9.8000	-0.277
10.0000	-0.267
11.0000	-0.286
12.0000	-0.305
13.0000	-0.305
14.0000	-0.325
15.0000	-0.334
16.0000	-0.344
17.0000	-0.353
18.0000	-0.363
19.0000	-0.372
20.0000	-0.382
21.0000	-0.382
22.0000	-0.391
23.0000	-0.401
24.0000	-0.401
25.0000	-0.411
26.0000	-0.411
27.0000	-0.420
28.0000	-0.430
29.0000	-0.430
30.0000	-0.430
31.0000	-0.439
32.0000	-0.449
33.0000	-0.449
34.0000	-0.458
35.0000	-0.458
36.0000	-0.449
37.0000	-0.458
38.0000	-0.468
39.0000	-0.468
40.0000	-0.468
41.0000	-0.478

42.0000	-0.478
43.0000	-0.478
44.0000	-0.487
45.0000	-0.487
46.0000	-0.487
47.0000	-0.497
48.0000	-0.497
49.0000	-0.497
50.0000	-0.506
51.0000	-0.506
52.0000	-0.506
53.0000	-0.516
54.0000	-0.516
55.0000	-0.516
56.0000	-0.516
57.0000	-0.525
58.0000	-0.525
59.0000	-0.516
60.0000	-0.525

SE1000C
Environmental Logger
08/31 12:22

Unit# 01513 Test 1

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.280
Scale factor	29.990
Offset	0.120
Delay mSEC	50.000

Step 0 08/31 08:16:17

Elapsed Time	INPUT 1
0.0000	18.801
0.0033	12.585
0.0066	11.728
0.0100	9.250
0.0133	4.461
0.0166	2.713
0.0200	5.033
0.0233	10.298
0.0266	14.099
0.0300	8.191
0.0333	3.811
0.0366	5.835
0.0400	4.088
0.0433	6.866
0.0466	16.708
0.0500	12.776
0.0533	13.157
0.0566	12.138
0.0600	13.462
0.0633	15.337
0.0666	16.327
0.0700	15.566
0.0733	13.604
0.0766	15.118
0.0800	12.700
0.0833	13.547
0.0866	14.033
0.0900	13.081
0.0933	13.300
0.0966	14.166
0.1000	15.052
0.1033	14.481
0.1066	13.243
0.1100	12.347
0.1133	12.214
0.1166	11.118
0.1200	13.061

0.1233	12.462
0.1266	9.498
0.1300	14.671
0.1333	15.023
0.1366	9.536
0.1400	11.938
0.1433	13.309
0.1466	14.281
0.1500	14.319
0.1533	14.985
0.1566	13.005
0.1600	10.870
0.1633	12.985
0.1666	12.833
0.1700	13.109
0.1733	14.471
0.1766	15.328
0.1800	14.842
0.1833	14.490
0.1866	13.833
0.1900	14.081
0.1933	14.195
0.1966	13.957
0.2000	13.900
0.2033	14.138
0.2066	13.747
0.2100	14.128
0.2133	14.090
0.2166	13.862
0.2200	14.099
0.2233	13.823
0.2266	13.871
0.2300	14.128
0.2333	14.328
0.2366	13.890
0.2400	13.947
0.2433	13.557
0.2466	13.823
0.2500	14.043
0.2533	13.795
0.2566	13.671
0.2600	13.509
0.2633	13.623
0.2666	13.652
0.2700	13.852
0.2733	13.947
0.2766	13.938
0.2800	13.833
0.2833	13.814
0.2866	13.928
0.2900	13.823
0.2933	13.823
0.2966	13.700
0.3000	14.052
0.3033	14.433
0.3066	14.471
0.3100	14.376
0.3133	14.471
0.3166	14.509
0.3200	14.376

0.3233	14.566
0.3266	14.519
0.3300	14.690
0.3333	14.709
0.3500	14.861
0.3666	16.280
0.3833	15.166
0.4000	14.261
0.4166	14.776
0.4333	15.033
0.4500	14.757
0.4666	14.909
0.4833	14.909
0.5000	14.871
0.5166	13.795
0.5333	12.623
0.5500	20.721
0.5666	15.252
0.5833	20.094
0.6000	13.881
0.6166	8.573
0.6333	3.974
0.6500	8.191
0.6666	8.372
0.6833	18.335
0.7000	18.344
0.7166	13.957
0.7333	21.310
0.7500	18.953
0.7666	18.287
0.7833	15.490
0.8000	13.509
0.8166	12.719
0.8333	12.614
0.8500	13.005
0.8666	9.746
0.8833	16.222
0.9000	14.547
0.9166	14.719
0.9333	14.261
0.9500	14.490
0.9666	14.576
0.9833	14.490
1.0000	28.213
1.2000	16.841
1.4000	17.307
1.6000	28.422
1.8000	29.001
2.0000	29.285
2.2000	29.475
2.4000	29.541
2.6000	29.740
2.8000	29.854
3.0000	29.968
3.2000	29.987
3.4000	30.129
3.6000	30.148
3.8000	30.224
4.0000	30.338
4.2000	30.271

4.4000	30.347
4.6000	30.366
4.8000	30.357
5.0000	30.366
5.2000	30.376
5.4000	30.423
5.6000	30.442
5.8000	30.451
6.0000	30.413
6.2000	30.423
6.4000	30.442
6.6000	30.480
6.8000	30.470
7.0000	30.480
7.2000	30.461
7.4000	30.451
7.6000	30.470
7.8000	30.499
8.0000	30.499
8.2000	30.499
8.4000	30.499
8.6000	30.565
8.8000	30.508
9.0000	30.518
9.2000	30.518
9.4000	30.575
9.6000	30.537
9.8000	30.546
10.0000	30.565
11.0000	30.527
12.0000	30.594
13.0000	27.103
14.0000	30.309
15.0000	30.423
16.0000	30.518
17.0000	30.470
18.0000	30.527
19.0000	30.556
20.0000	30.546
21.0000	30.527
22.0000	30.556
23.0000	30.546
24.0000	30.594
25.0000	30.556
26.0000	30.556
27.0000	30.565
28.0000	30.556
29.0000	30.499
30.0000	30.546
31.0000	30.537
32.0000	28.043
33.0000	30.537
34.0000	30.565
35.0000	30.575
36.0000	30.556
37.0000	30.556
38.0000	30.584
39.0000	30.584
40.0000	30.565
41.0000	30.565

42.0000	30.603
43.0000	30.613
44.0000	30.584
45.0000	30.679
46.0000	30.736
47.0000	30.717
48.0000	30.717
49.0000	30.755
50.0000	30.707
51.0000	30.736
52.0000	30.726
53.0000	30.726
54.0000	30.736
55.0000	30.745
56.0000	30.745
57.0000	30.745
58.0000	29.579
59.0000	30.669
60.0000	30.698

SE1000C
Environmental Logger
08/31 12:26

Unit# 01513 Test 2

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	0.000
Linearity	0.280
Scale factor	29.990
Offset	0.120
Delay mSEC	50.000

Step 0 08/31 09:17:46

Elapsed Time	INPUT 1
0.0000	30.669
0.0033	30.726
0.0066	30.717
0.0100	30.698
0.0133	28.033
0.0166	23.591
0.0200	30.745
0.0233	31.560
0.0266	32.508
0.0300	32.527
0.0333	31.665
0.0366	29.295
0.0400	29.456
0.0433	28.052
0.0466	29.076
0.0500	29.219
0.0533	27.948
0.0566	27.359
0.0600	27.189
0.0633	27.236
0.0666	26.676
0.0700	27.739
0.0733	29.883
0.0766	27.075
0.0800	23.809
0.0833	27.397
0.0866	26.543
0.0900	27.322
0.0933	23.828
0.0966	26.012
0.1000	24.388
0.1033	23.581
0.1066	23.154
0.1100	23.021
0.1133	21.881
0.1166	21.767
0.1200	22.147

0.1233	21.310
0.1266	20.550
0.1300	20.759
0.1333	19.809
0.1366	20.227
0.1400	19.152
0.1433	19.010
0.1466	19.343
0.1500	17.954
0.1533	17.745
0.1566	18.943
0.1600	17.773
0.1633	17.631
0.1666	16.946
0.1700	16.679
0.1733	16.746
0.1766	15.946
0.1800	15.718
0.1833	15.927
0.1866	15.623
0.1900	15.109
0.1933	15.908
0.1966	15.985
0.2000	14.385
0.2033	15.252
0.2066	14.614
0.2100	13.776
0.2133	13.424
0.2166	14.823
0.2200	14.347
0.2233	15.071
0.2266	14.214
0.2300	13.728
0.2333	13.223
0.2366	12.947
0.2400	12.728
0.2433	12.881
0.2466	11.947
0.2500	13.071
0.2533	11.518
0.2566	11.166
0.2600	12.290
0.2633	11.737
0.2666	12.071
0.2700	11.842
0.2733	11.023
0.2766	11.118
0.2800	11.661
0.2833	10.689
0.2866	11.451
0.2900	10.613
0.2933	11.290
0.2966	10.594
0.3000	9.850
0.3033	10.136
0.3066	9.526
0.3100	10.308
0.3133	9.774
0.3166	9.355
0.3200	9.850

0.3233	9.440
0.3266	9.050
0.3300	9.193
0.3333	9.136
0.3500	8.649
0.3666	8.029
0.3833	7.905
0.4000	7.304
0.4166	7.037
0.4333	6.923
0.4500	6.675
0.4666	6.474
0.4833	4.355
0.5000	3.830
0.5166	3.639
0.5333	3.515
0.5500	3.410
0.5666	3.238
0.5833	3.057
0.6000	2.837
0.6166	2.751
0.6333	2.713
0.6500	2.646
0.6666	2.474
0.6833	2.465
0.7000	2.407
0.7166	2.331
0.7333	2.302
0.7500	2.245
0.7666	2.188
0.7833	2.130
0.8000	2.083
0.8166	2.035
0.8333	1.997
0.8500	1.930
0.8666	1.891
0.8833	1.844
0.9000	1.796
0.9166	1.758
0.9333	1.720
0.9500	1.662
0.9666	1.634
0.9833	1.605
1.0000	1.557
1.2000	1.118
1.4000	0.812
1.6000	0.611
1.8000	0.468
2.0000	0.372
2.2000	0.315
2.4000	0.258
2.6000	0.200
2.8000	0.162
3.0000	0.133
3.2000	0.095
3.4000	0.066
3.6000	0.028
3.8000	0.000
4.0000	-0.019
4.2000	-0.038

4.4000	-0.066
4.6000	-0.076
4.8000	-0.095
5.0000	-0.114
5.2000	-0.133
5.4000	-0.143
5.6000	-0.152
5.8000	-0.181
6.0000	-0.191
6.2000	-0.200
6.4000	-0.210
6.6000	-0.229
6.8000	-0.238
7.0000	-0.238
7.2000	-0.257
7.4000	-0.267
7.6000	-0.277
7.8000	-0.277
8.0000	-0.296
8.2000	-0.296
8.4000	-0.305
8.6000	-0.315
8.8000	-0.325
9.0000	-0.334
9.2000	-0.334
9.4000	-0.344
9.6000	-0.353
9.8000	-0.353
10.0000	-0.363
11.0000	-0.382
12.0000	-0.420
13.0000	-0.430
14.0000	-0.449
15.0000	-0.478
16.0000	-0.487
17.0000	-0.497
18.0000	-0.506
19.0000	-0.525
20.0000	-0.535
21.0000	-0.544
22.0000	-0.554
23.0000	-0.554
24.0000	-0.573
25.0000	-0.573
26.0000	-0.582
27.0000	-0.582
28.0000	-0.602
29.0000	-0.602
30.0000	-0.611
31.0000	-0.611
32.0000	-0.621
33.0000	-0.621
34.0000	-0.621
35.0000	-0.630
36.0000	-0.630
37.0000	-0.640
38.0000	-0.640
39.0000	-0.649
40.0000	-0.649
41.0000	-0.649

42.0000	-0.649
43.0000	-0.669
44.0000	-0.659
45.0000	-0.659
46.0000	-0.659
47.0000	-0.669
48.0000	-0.678
49.0000	-0.678
50.0000	-0.669
51.0000	-0.678
52.0000	-0.669
53.0000	-0.688
54.0000	-0.678
55.0000	-0.688
56.0000	-0.678
57.0000	-0.678
58.0000	-0.688
59.0000	-0.688
60.0000	-0.688