HYDROLOGIC ASSOCIATES U.S.A., INC.
ENVIRONMENTAL CONSULTANTS
8925 S. W. 148th Street, Suite 212, Miami, Florida 33176
Phone: (305) 252-7118 • Fax: (305) 254-0874

November 1, 1993

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 two potential monitoring zones within the Floridan Aquifer system penetrated by Injection well I-13. The straddle packer test and subsequent hydraulic analysis were conducted in the zones of the aquifer between 1500 and 1560 feet and 1750 to 1810 feet below land surface.

METHOD

A straddle packer was used to isolate the test zones for drawdown and recovery tests. Stress was imposed on the hydraulic system with a 4 inch submersible pump and 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 wells were developed by pumping the formation fluid until the specific conductance stabilized (Appendix 1). The well was then allowed to recover from development before performing the test.

BACKGROUND

A 12 1/4 inch pilot hole was drilled below casing to a depth of 1920 feet below land surface. A suite of geophysical logs were run and, together with the borehole cutting samples, two test zones were selected by the WASA project hydrogeologist. A lower zone was selected between 1750-1810 feet below land surface and an upper, zone from 1500-1560 feet below land surface. Each zone was isolated with an inflatable straddle packer, 60 feet long, with about 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 1750-1810 feet B.L.S. The packer elements were then inflated. A submersible pump was installed in the drill stem to develop the formation fluids between the packer elements. After over six hours of pumping, a constant specific conductance of 33,500 umhos was reached. The well was then allowed to recover to its initial antecedent conditions. The well was then pumped while drawdown data was recorded. Recovery data were recorded until formation water level had again reached antecedent conditions. Background, drawdown and recovery water level data is graphed on Figures 1 and 2. Raw data are presented in Appendix III.

The packer assembly was then raised to the 1500 to 1560 feet below land surface zone. The same procedure as above was then followed. The specific conductance for the upper zone stabilized at 10,000 umhos. Water quality data was collected and analysed by Rio Palenque Research Corporation for NO_2, NO_3, $N0_4$, TKN, SO_4, Chloride, Alkalinity, TDS, and Zinc. These data are presented in Appendix II.

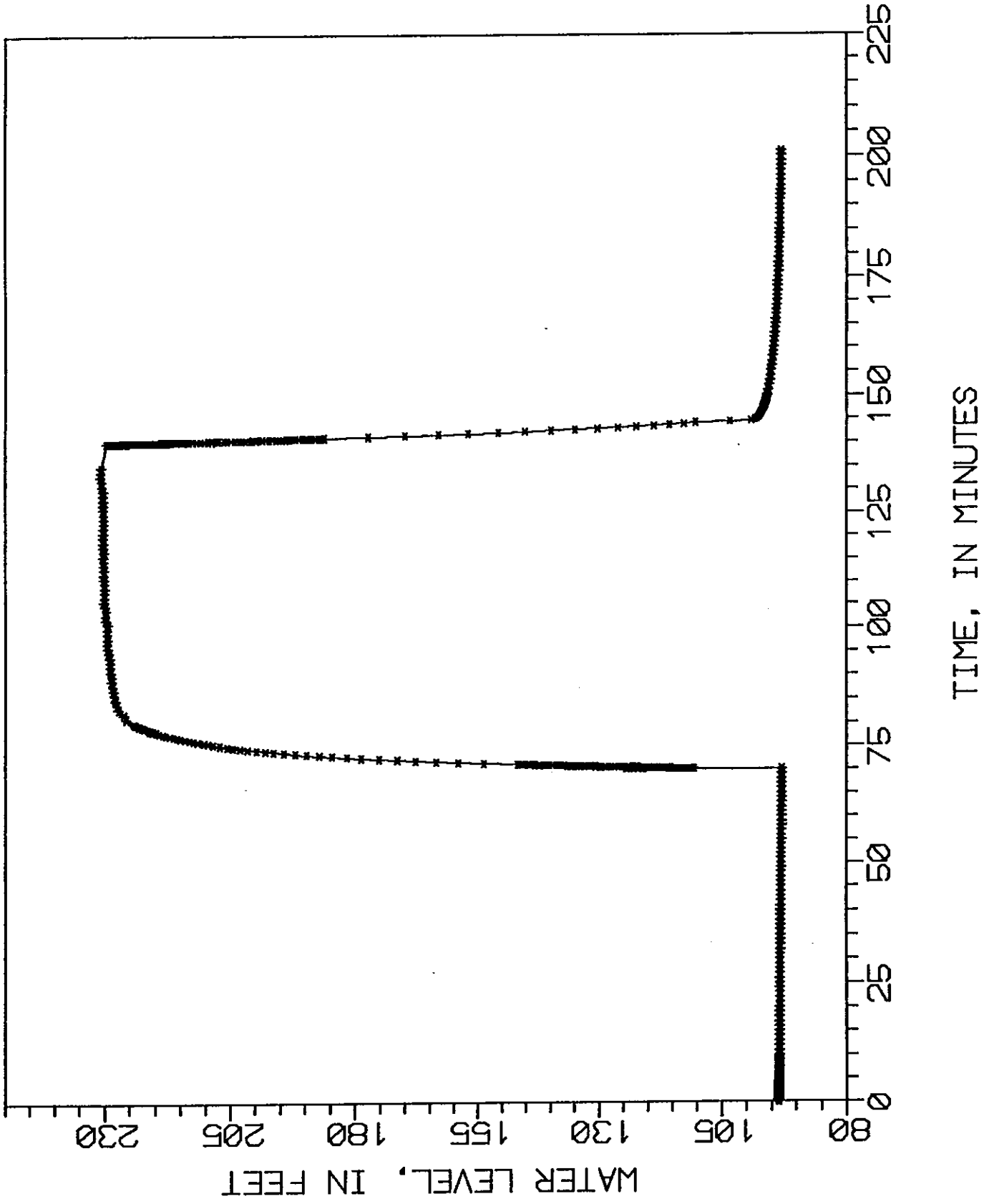


Figure 1.-- Background, drawdown and recovery data from 1750 to 1810 zone, arbitrary datum.

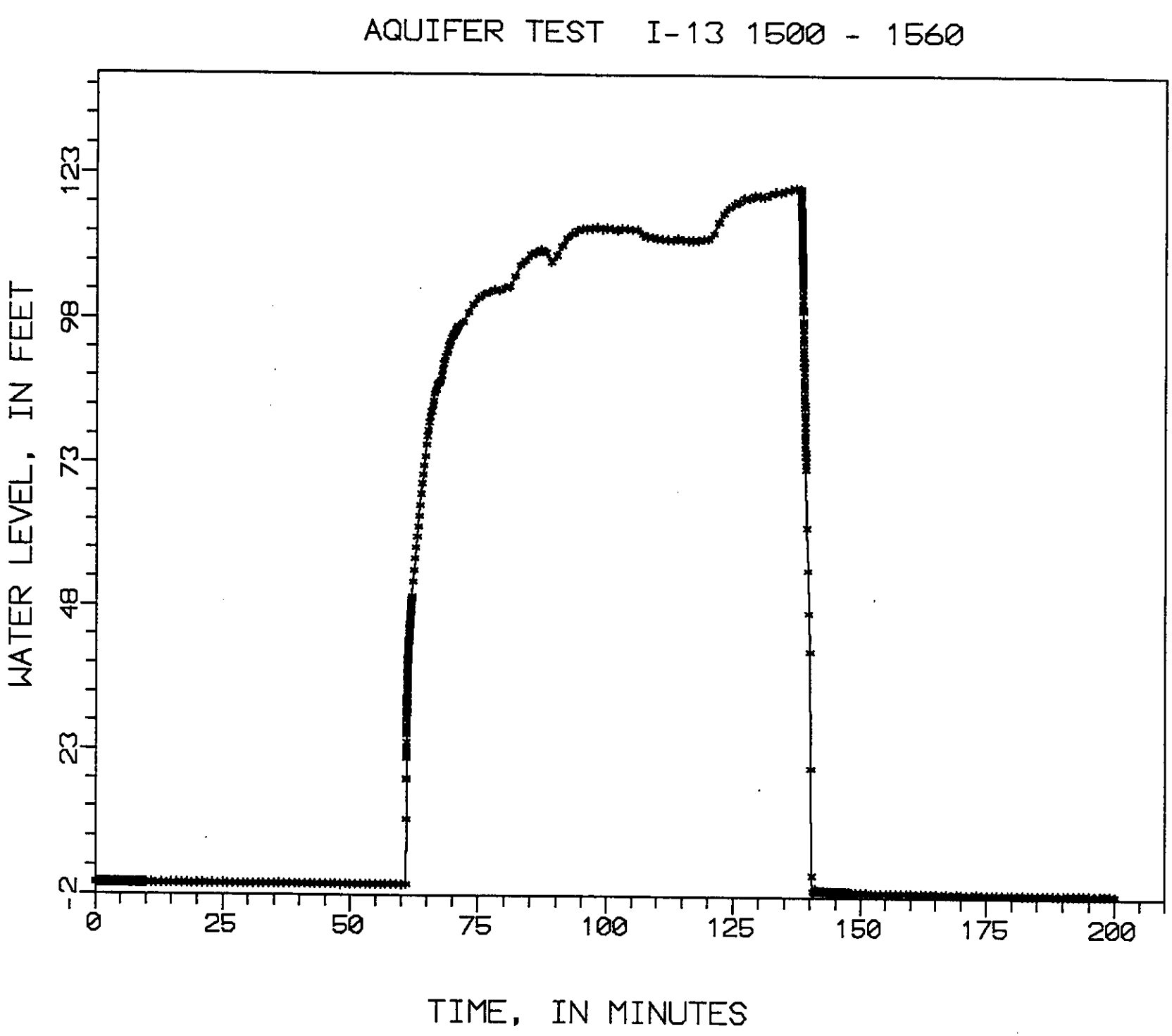


Figure 2.-- Background, drawdown and recovery data from 1500 to 1560 zone, arbitrary datum.

DATA ANALYSIS, UPPER AND LOWER ZONE

Three methods of data analysis are used to calculate the transmissivity for the upper packer setting between 1500 and 1560 feet below land surface and at the lower packer setting, between 1750 and 1810 feet below land surface, and are as follows:

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

1. Cooper-Jacob Analysis

The Cooper-Jacob method (figure 3 and 4) (Todd, 1980 p. 129) was used to compute a transmissivity value. The equation is as follows:

$$T = \frac{(2.3)(Q)}{(4)(\pi)(\Delta s_t)}$$

where Q= discharge in cubic feet per day
s_t= drawdown over one log cycle of time

The data were plotted on semi-log paper (s verses log t) and a straight line is fitted to the data. Some packer leakage is indicated as points of intermittant recoveries indicated on the time drawdown graph (Figure 3).

Using the observed drawdown over a single log cycle, (s), the transmissivity can be determined from the equation given by Todd (1980, p. 130) as:

UPPER UNIT

$$T = \frac{2.3\ (15115)\ ft^3/day}{(4)\ (3.1416)\ (58 ft)}$$

T = 354.6 gal/day/ft

LOWER UNIT

$$T = \frac{2.3\ (12608.75)\ ft^3/day}{(4)\ (3.1416)\ (80\ ft)}$$

T = 215.9 gal/day/ft

Using a unit thickness of 60 ft., the horizontal hydraulic conductivity is:

UPPER UNIT

k = 5.9 gal/day/sq.ft
k = .0003 cm/sec.

LOWER UNIT

k = 3.60 gal/day/sq.ft.
k = .0002 cm/sec

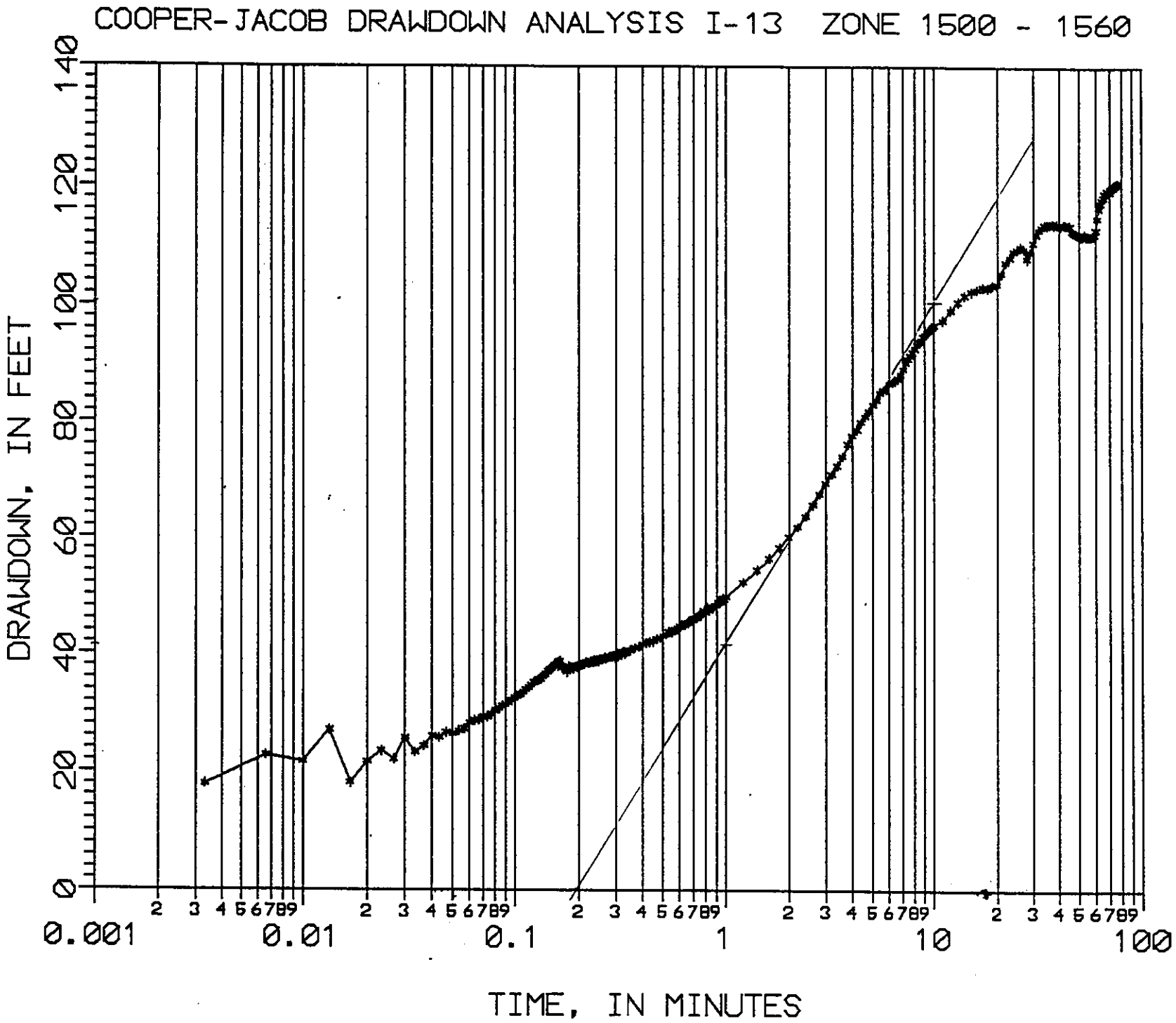


Figure 3.-- Cooper-Jacob Drawdown Analysis I-13, zone 1500-1560

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) by using the computer package GWAP (Graphical Well Analysis Package). Figures 5 and 6 show 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:

UPPER UNIT	LOWER UNIT
K = 12.7 gal/day/sq.ft.	K = 8.2 gal/day/sq.ft.
K = .0006 cm/sec	K = .0004 cm/sec

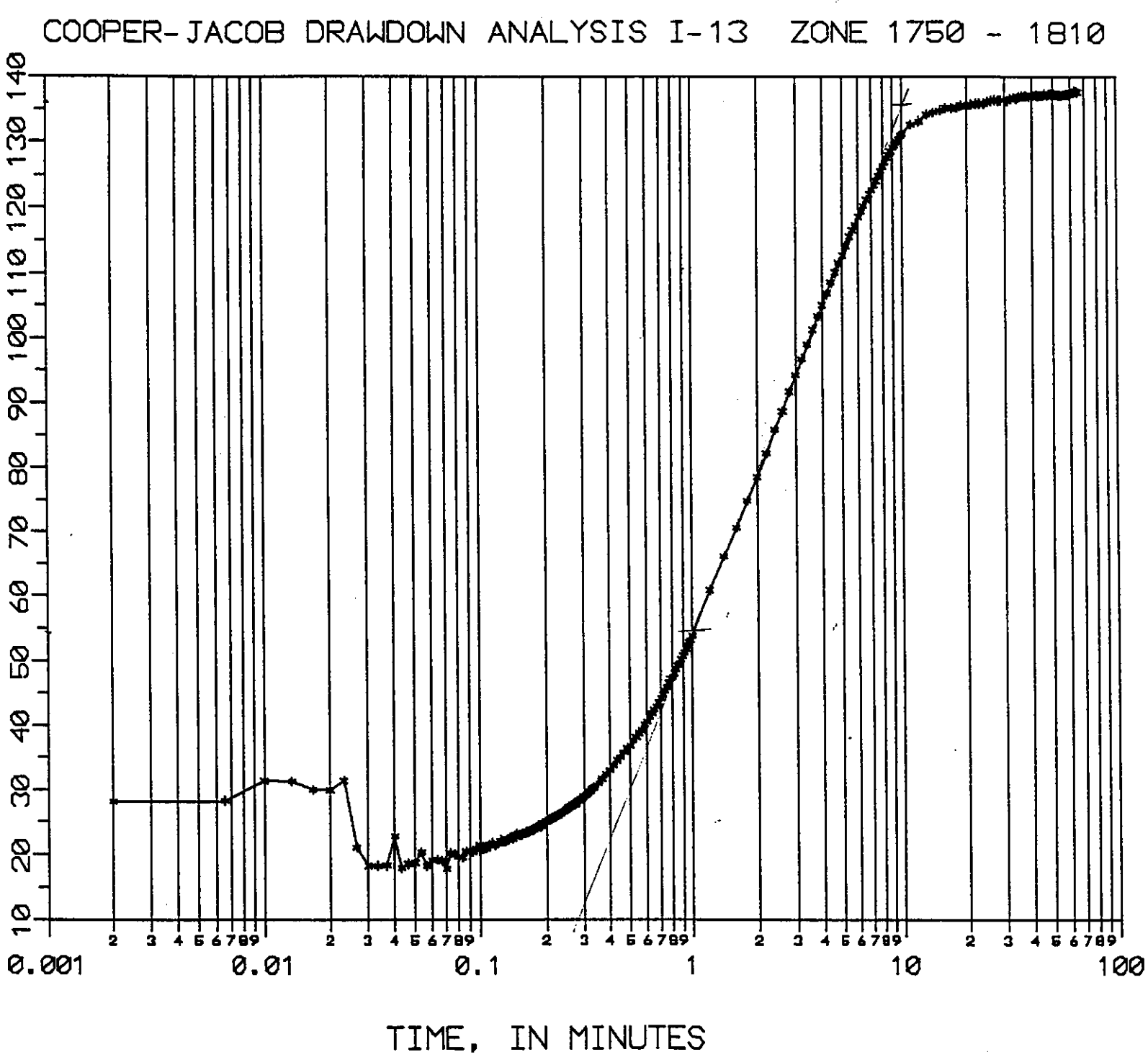
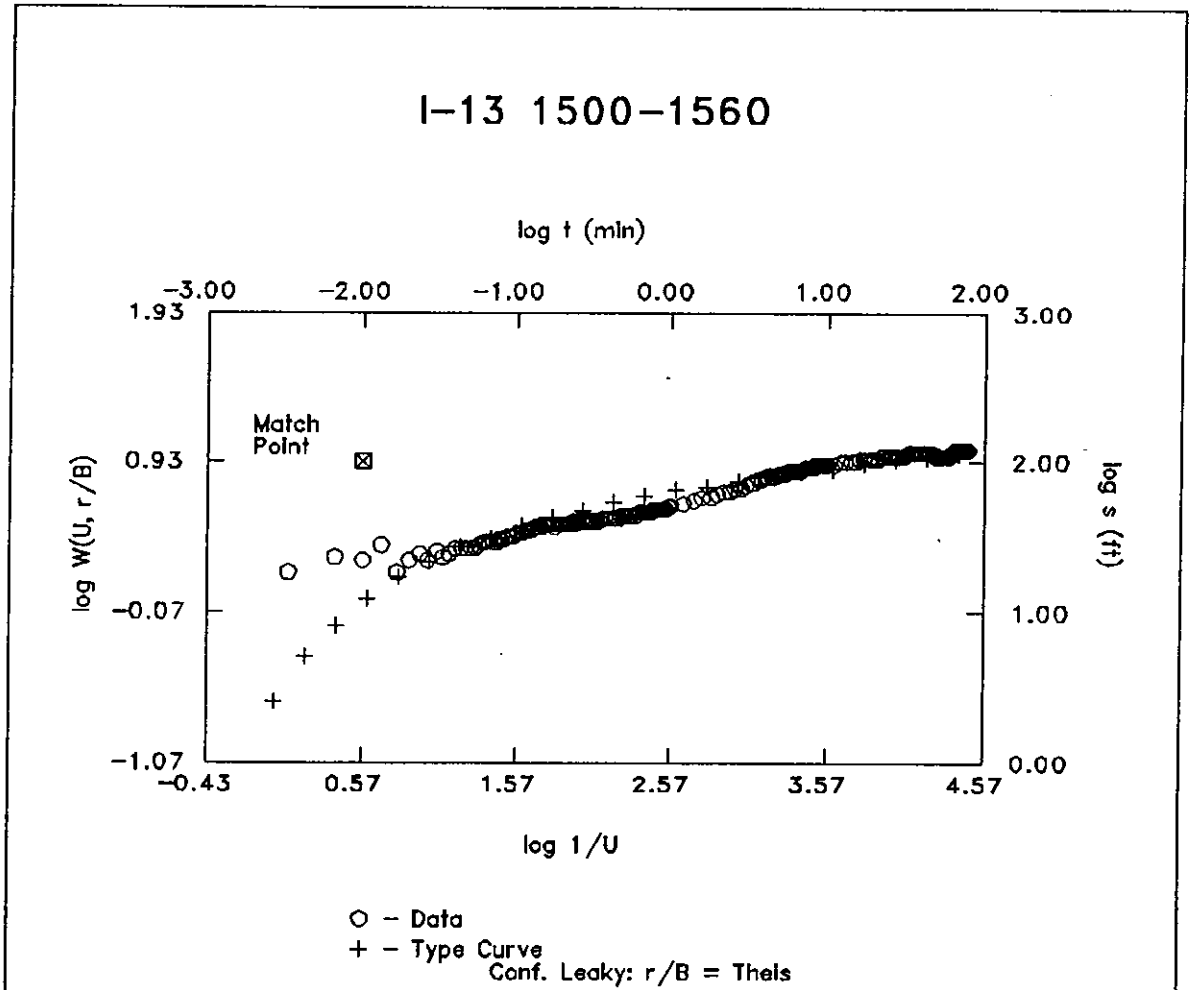


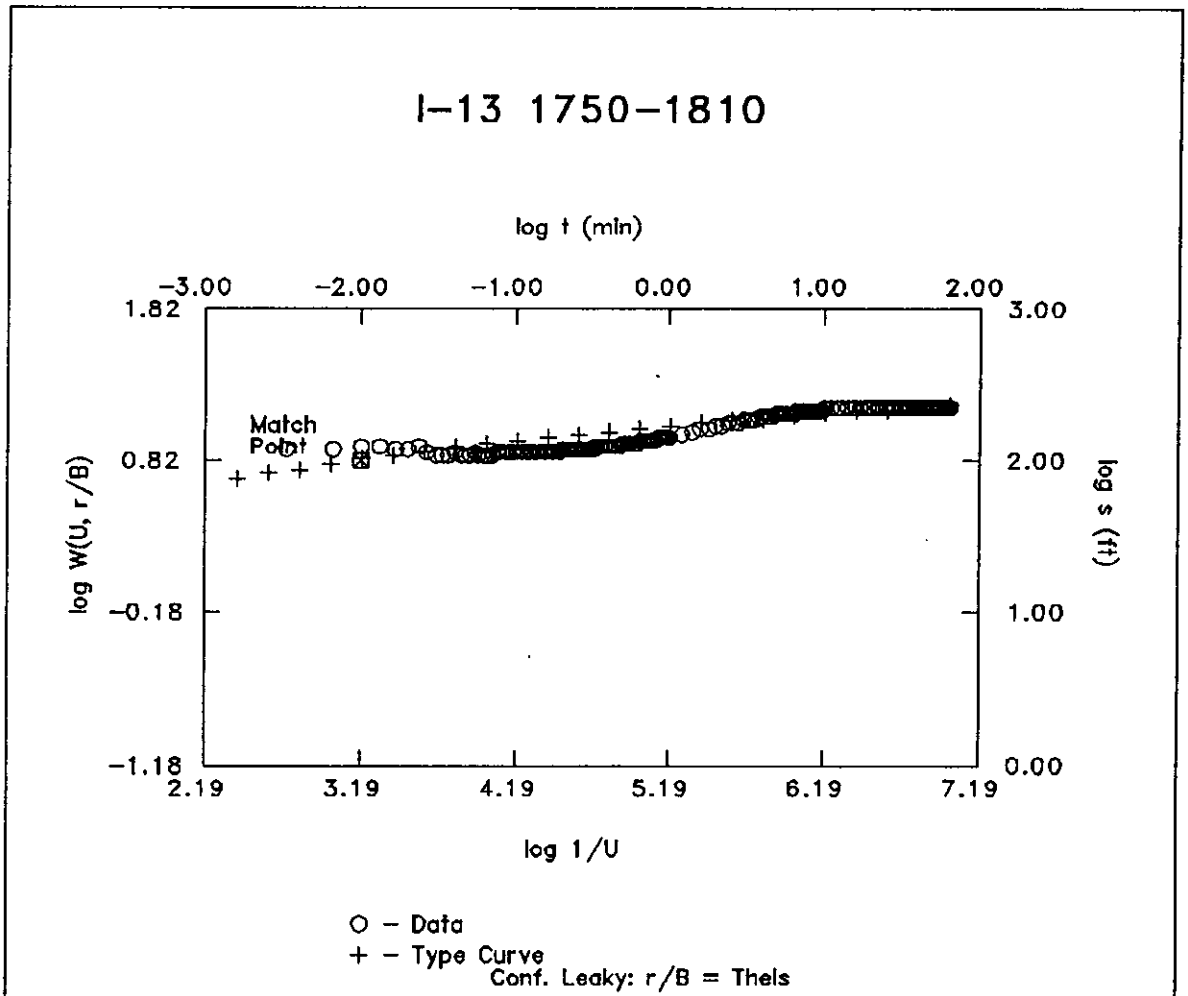
Figure 4.-- Cooper-Jacob Drawdown Analysis I-13, zone 1750-1810



MATCH POINT			SOLUTION		
t	=	1.000E-0002	Transmissivity (T)	=	7.606E+0002 gpd/ft
s	=	1.000E+0002	Hydraulic Conductivity (K)	=	1.268E+0001 gpd/sq ft
1/U	=	3.715E+0000	Storativity (S)	=	2.923E-0003
W(U, r/B)	=	8.511E+0000			

WELL INFORMATION	
WELL IDENTIFICATION	: I-13 155
DATE OF AQUIFER TEST	: 10\17\93
AQUIFER THICKNESS (b)	: 6.000E+0001 ft
DISCHARGE RATE (Q)	: 7.800E+0001 gpm
PUMPING WELL RADIUS (r)	: 5.100E-0001 ft
DISTANCE OF OBSERVATION WELL FROM PUMPING WELL (d)	: 5.100E-0001 ft

Figure 5.--Theis Leaky Curve Analysis I-13, zone 1500-1560



MATCH POINT			SOLUTION		
t	=	1.000E-0002	Transmissivity (T)	=	4.920E+0002 gpd/ft
s	=	1.000E+0002	Hydraulic Conductivity (K)	=	8.200E+0000 gpd/sq ft
1/U	=	1.549E+0003	Storativity (S)	=	4.536E-0006
W(U, r/B)	=	6.607E+0000			

WELL INFORMATION	
WELL IDENTIFICATION	: I-13 175
DATE OF AQUIFER TEST	: 10\16\93
AQUIFER THICKNESS (b)	: 6.000E+0001 ft
DISCHARGE RATE (Q)	: 6.500E+0001 gpm
PUMPING WELL RADIUS (r)	: 5.100E-0001 ft
DISTANCE OF OBSERVATION WELL FROM PUMPING WELL (d)	: 5.100E-0001 ft

Figure 6.--Theis Leaky Curve Analysis I-13, zone 1750-1810

3. Theis Recovery Analysis

The Theis Method was used to analyze recovery in the well after the pump was shut down, 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 pumping to the time of shut down (t/t') (see figure 7 and 8).

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: $T = \frac{(2.3)(Q)}{(4)(\pi)(\Delta s_t)}$ Todd (1980, p. 134):

UPPER UNIT

$$T = \frac{(2.30)(15015)\ ft^3/day}{(4)\ (3.1416)(103\ ft)}$$

$$= 199.7 \text{ gal/day/ft}$$

LOWER UNIT

$$T = \frac{(2.3)(12608.75)\ ft^3/day}{(4)(3.1416)(132\ ft)}$$

$$= 130.8 \text{ gal/day/ft}$$

Horizontal hydraulic conductivity is calculated by dividing T by the unit thickness of 60.0 ft.

	UPPER UNIT	LOWER UNIT
K =	3.32 gal/day/sq.ft.	= 3.3 gal/day/sq.ft.
=	.00016 cm/sec.	= .00016 cm/sec

Analytical results of the tests are summarized as follows:

Hydraulic Conductivity

	UPPER UNIT	LOWER UNIT
Theis	= 6×10^{-4}	= 4×10^{-4}
Cooper-Jacob	= 3×10^{-4}	= 2×10^{-4}
Theis Recovery	= 1.6×10^{-4}	= 1.6×10^{-4}

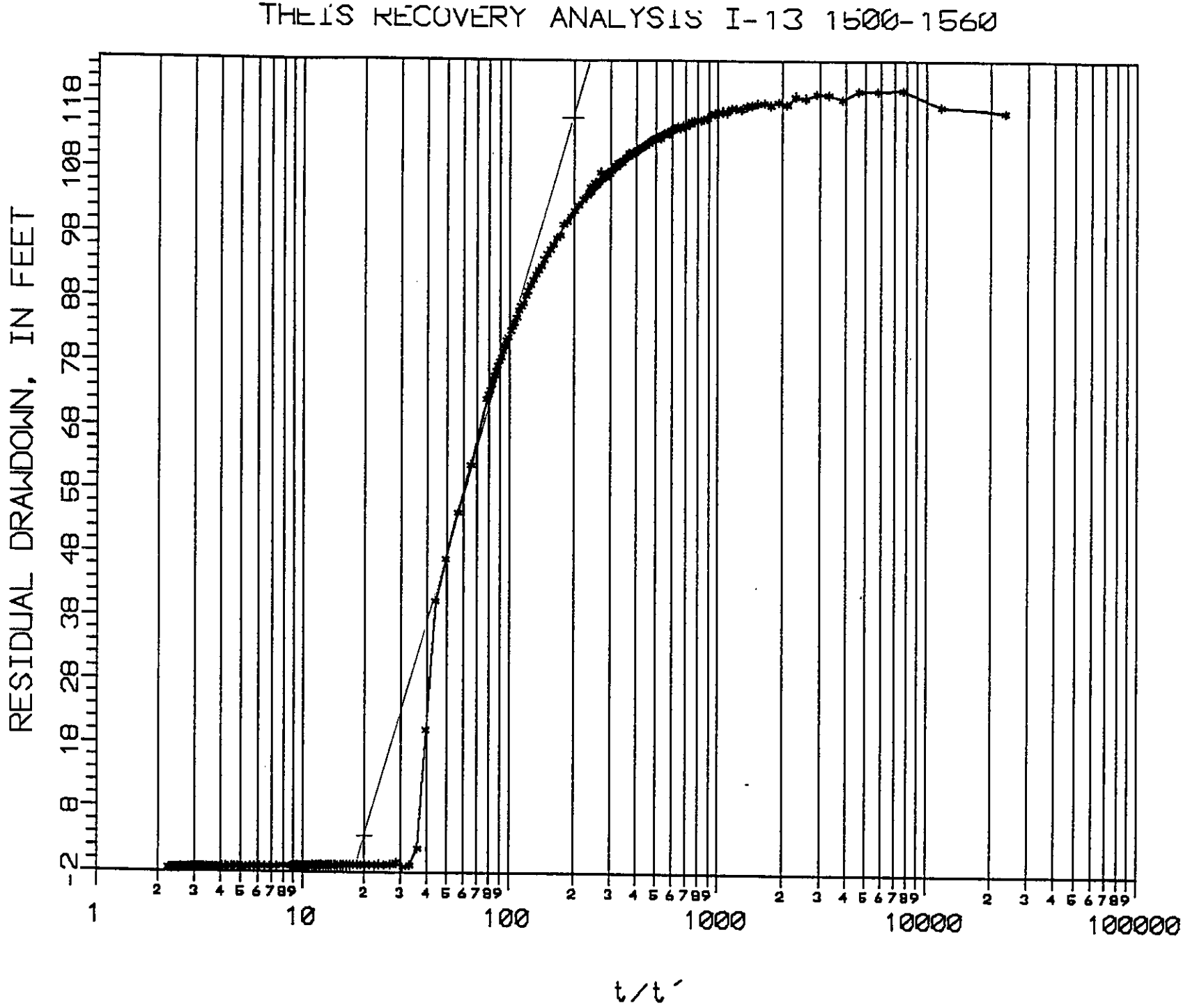


Figure 7.-- Theis Recovery Analysis I-13, zone 1500-1560

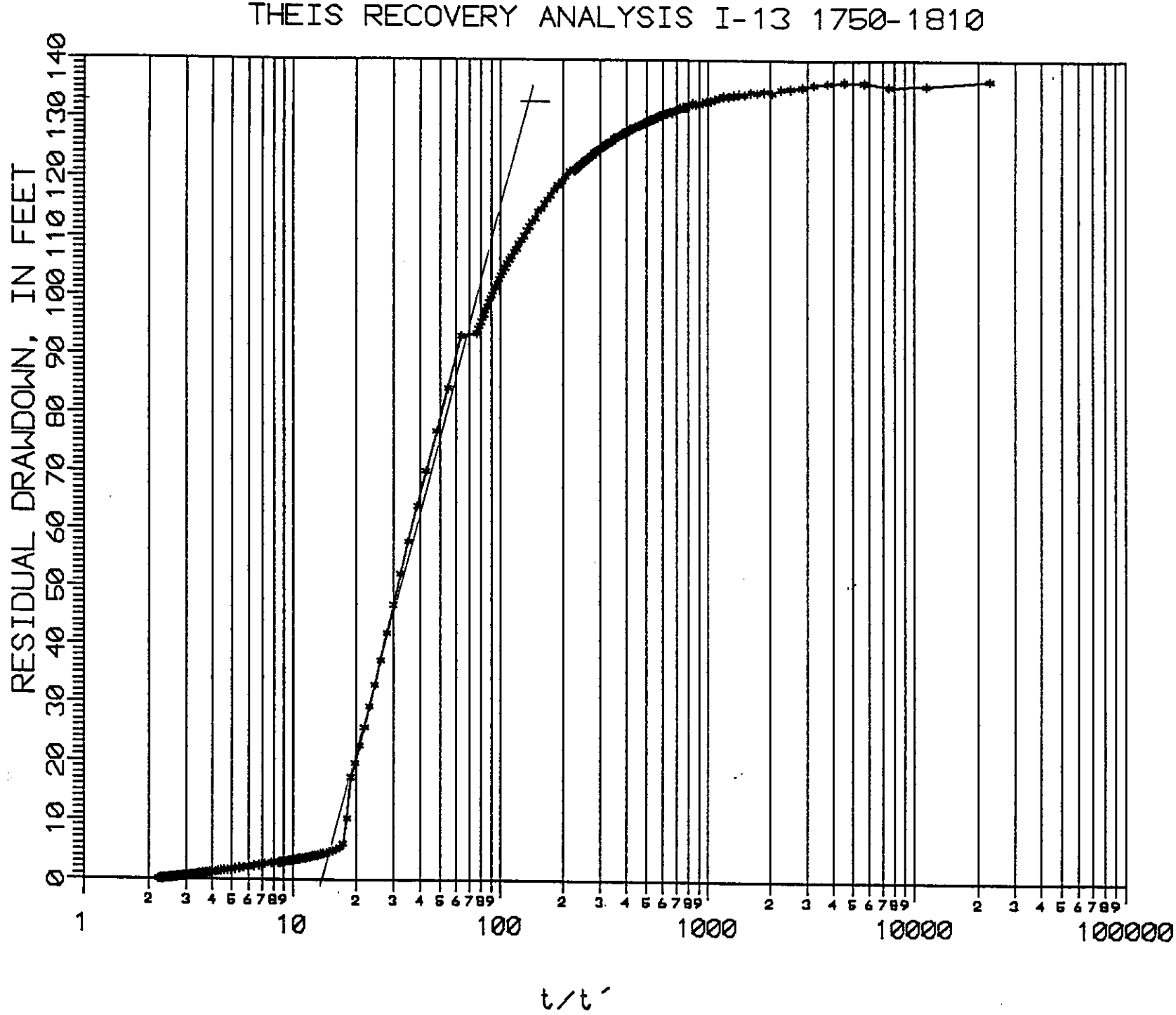


Figure 8.-- Theis Recovery Analysis I-13, zone 1750-1810

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

Sincerely,

Edmand B. Workman, P.G.

EBW/na

11/1/93

Appendix I
Specific Conductance Stabilization Data

I-13 1750'-1810' 10/16/93

TEMP °C	CONDUCTIVITY umhos	TIME
26.5	4100	06:00
26.5	**4800**	**06:15**
26.5	5400	06:30
26.5	**6100**	**06:45**
26.5	6300	07:00
26.5	**6900**	**07:15**
26.5	7700	07:30
26.5	**8500**	**07:45**
26.5	8700	08:00
26.5	**9800**	**08:15**
26.5	10100	08:30
26.5	**11500**	**08:45**
26.5	12300	09:00
26.4	**16000**	**09:15**
26.8	22000	09:30
27	**24000**	**09:45**
27	26500	10:00
27	**31000**	**10:30**
27	31500	11:00
27	**32000**	**11:10**
27	32500	11:20
27	**33000**	**11:30**
27	33000	11:40
27	**33000**	**11:50**
27	33500	12:00
27	**33500**	**12:10**
27	33,500	12:20

I-13 1500'-1550' 10-17-93

TEMP°C	CONDUCTIVITY umhos	TIME
26	7800	12:00 midnight
26	**7800**	**0:15**
27	7800	0:30
27	**8000**	**0:45**
27	8800	1:00
27	**9200**	**1:15**
27	9300	1:30
27	**9500**	**1:45**
27	9800	2:00
27	**9850**	**2:15**
27	9850	2:30
27	**9900**	**2:45**
27	9900	2:45
27	**9900**	**3:00**
27	9950	3:15
27	**9950**	**3:30**
27	9950	3:45
27	**9950**	**4:00**
27	10000	4:15
27	**10000**	**4:30**
27	10000	4:45
27	**10000**	**5:00**
27	10000	5:15
27	**10000**	**5:30**
27	10000	5:45
27	**10000**	**6:00**
27	10000	6:15
27	**10000**	**6:30**
27	10000	6:45
27	**10000**	**07:00**
27	10000	07:15

27	**10000**	**07:30**
27	10000	07:45
26	**10000**	**08:00**
26	10000	08:15
25	**8000**	**08:30**
25	10000	08:45

Appendix II
Laboratory Analysis Results

RIO PALENQUE RESEARCH CORPORATION
12246 S.W. 131st AVENUE • MIAMI, FLORIDA 33186 • TEL. (305) 233-5789

CLIENT: Hydrologic Associates

SOURCE: I 13
SAMPLE DATE: 10/16/93
SAMPLE RECEIVED IN LAB: 10/18/93

SAMPLED BY: Client
DATE ANALYZED: Nuts-10/18, rest 10/21/93
ANALYST: D.Rich

Florida DHRS Certification #E86147, FDER CompQAP #870352G
These analyses were performed in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methodology.

		mg/l							
Log #	Sample	NO_3-N	NO_2-N	NH_4-N	TKN	SO_4	Chloride	Alkalinity	TDS
D1153	1500-1660'	<.01	<.01	2.35	2.13	580	4390	203	8230
D1154	1750-1810'	<.01	<.01	0.20	0.20	1650	17100	196	29000

		alpha units
		Color
D1153	1500-1660'	10
D1154	1750-1810'	20

SPECTROANALYTICA

INCORPORATED

EXECUTIVE OFFICES
4020 Salzedo Street
Coral Gables, FL 33146
305/446-0060
FAX/446-0782

LABORATORY
7019 SW 13 Street
Miami, FL 33144
305/262-2883

October 21, 1993

TO: Rio Palenque Research, Inc.
12246 SW 131 Avenue
Miami, FL 33186

STATE OF FLORIDA
CERTIFICATION NO. E86184

==========

RE: Hydrologic Associates I-13 Job #1169

Water/Total

ANAL. NO.	SAMPLE NO.	Zn ppm
5338	1500/1600'	0.10
5339	1750/1810'	0.11

SPECTROANALYTICA, INC.

Max Flandorfer

Max Flandorfer, Analyst
Date of Analysis: October 19, 1993

Appendix III
Raw Aquifer Test Data

I-13
1500-1560
BACKGROUND DATA

TIME	WATER LEVEL
0.0000	0.0330
0.0033	0.0000
0.0066	-0.0300
0.0100	0.0000
0.0133	0.0000
0.0166	0.0330
0.0200	0.0330
0.0233	-0.0300
0.0266	0.0000
0.0300	0.0000
0.0333	0.0000
0.0366	0.0330
0.0400	0.0000
0.0433	0.0000
0.0466	0.0000
0.0500	-0.0300
0.0533	0.0000
0.0566	0.0330
0.0600	0.0000
0.0633	-0.0300
0.0666	-0.0300
0.0700	0.0330
0.0733	0.0000
0.0766	0.0000
0.0800	0.0330
0.0833	0.0000
0.0866	0.0000
0.0900	0.0000
0.0933	-0.0300
0.0966	0.0000
0.1000	0.0000
0.1033	0.0000
0.1066	0.0330
0.1100	0.0000
0.1133	0.0000
0.1166	0.0000
0.1200	0.0000
0.1233	0.0000
0.1266	0.0000
0.1300	0.0000
0.1333	0.0000
0.1366	0.0000
0.1400	0.0000
0.1433	0.0000
0.1466	0.0000
0.1500	0.0000
0.1533	0.0000
0.1566	0.0330
0.1600	0.0000
0.1633	0.0000
0.1666	0.0330
0.1700	-0.0300
0.1733	0.0000
0.1766	0.0000

0.1800	-0.0300
0.1833	0.0000
0.1866	0.0000
0.1900	0.0000
0.1933	0.0000
0.1966	0.0000
0.2000	0.0000
0.2033	0.0330
0.2066	0.0000
0.2100	0.0330
0.2133	0.0000
0.2166	0.0000
0.2200	0.0000
0.2233	-0.0300
0.2266	0.0000
0.2300	0.0000
0.2333	0.0000
0.2366	0.0000
0.2400	0.0000
0.2433	0.0000
0.2466	0.0000
0.2500	0.0000
0.2533	0.0330
0.2566	0.0000
0.2600	0.0330
0.2633	0.0330
0.2666	0.0000
0.2700	0.0000
0.2733	0.0000
0.2766	0.0000
0.2800	0.0000
0.2833	0.0000
0.2866	0.0000
0.2900	0.0330
0.2933	0.0330
0.2966	0.0000
0.3000	0.0000
0.3033	0.0000
0.3066	0.0000
0.3100	0.0000
0.3133	0.0330
0.3166	0.0000
0.3200	0.0330
0.3233	0.0000
0.3266	-0.0300
0.3300	0.0000
0.3333	0.0000
0.3500	0.0000
0.3666	0.0330
0.3833	0.0000
0.4000	0.0330
0.4166	0.0000
0.4333	0.0330
0.4500	0.0000
0.4666	0.0330
0.4833	0.0000
0.5000	-0.0300
0.5166	0.0330
0.5333	0.0000
0.5500	0.0000

0.5666	0.0330
0.5833	0.0000
0.6000	0.0000
0.6166	0.0330
0.6333	0.0000
0.6500	0.0330
0.6666	0.0330
0.6833	0.0000
0.7000	0.0000
0.7166	0.0000
0.7333	0.0000
0.7500	0.0000
0.7666	0.0000
0.7833	0.0330
0.8000	0.0000
0.8166	0.0000
0.8333	0.0330
0.8500	0.0000
0.8666	0.0000
0.8833	0.0330
0.9000	0.0330
0.9166	-0.0300
0.9333	0.0330
0.9500	0.0000
0.9666	0.0000
0.9833	0.0000
1.0000	0.0330
1.2000	0.0000
1.4000	0.0000
1.6000	0.0000
1.8000	0.0000
2.0000	0.0000
2.2000	0.0330
2.4000	0.0000
2.6000	0.0000
2.8000	0.0000
3.0000	0.0000
3.2000	0.0000
3.4000	-0.0300
3.6000	0.0000
3.8000	0.0000
4.0000	0.0000
4.2000	0.0000
4.4000	0.0000
4.6000	0.0000
4.8000	-0.0300
5.0000	0.0000
5.2000	0.0000
5.4000	0.0000
5.6000	-0.0300
5.8000	-0.0300
6.0000	-0.0300
6.2000	0.0000
6.4000	-0.0300
6.6000	0.0000
6.8000	-0.0620
7.0000	0.0000
7.2000	-0.0300
7.4000	-0.0300
7.6000	-0.0300

7.8000	-0.0620
8.0000	-0.0300
8.2000	-0.0300
8.4000	0.0000
8.6000	-0.0300
8.8000	-0.0300
9.0000	-0.0300
9.2000	0.0000
9.4000	0.0000
9.6000	0.0000
9.8000	0.0000
10.0000	-0.0300
11.0000	0.0000
12.0000	-0.0620
13.0000	-0.0300
14.0000	-0.0620
15.0000	-0.0300
16.0000	-0.0300
17.0000	0.0000
18.0000	-0.0300
19.0000	-0.0620
20.0000	-0.0300
21.0000	0.0000
22.0000	-0.0620
23.0000	-0.0300
24.0000	-0.0620
25.0000	-0.0300
26.0000	-0.0620
27.0000	-0.0620
28.0000	-0.0620
29.0000	-0.0620
30.0000	-0.0620
31.0000	-0.0620
32.0000	-0.0620
33.0000	-0.0940
34.0000	-0.0620
35.0000	-0.0620
36.0000	-0.0300
37.0000	-0.0620
38.0000	-0.0620
39.0000	-0.0940
40.0000	-0.0940
41.0000	-0.0940
42.0000	-0.0620
43.0000	-0.0620
44.0000	-0.0620
45.0000	-0.0620
46.0000	-0.0940
47.0000	-0.0940
48.0000	-0.1260
49.0000	-0.0940
50.0000	-0.0940
51.0000	-0.0620
52.0000	-0.0940
53.0000	-0.0940
54.0000	-0.0940
55.0000	-0.0940
56.0000	-0.0940
57.0000	-0.0620
58.0000	-0.0940

59.0000	-0.0940
60.0000	-0.1260
61.0000	-0.0940

I-13
ZONE 1500-1560
DRAWDOWN TEST DATA

TIME	WATER LEVEL
0.0000	10.9910
0.0033	17.8170
0.0066	22.7680
0.0100	21.6250
0.0133	27.0520
0.0166	18.0390
0.0200	21.6890
0.0233	23.4980
0.0266	22.0390
0.0300	25.6870
0.0333	23.2120
0.0366	24.3230
0.0400	25.9730
0.0433	25.7190
0.0466	26.6080
0.0500	26.2900
0.0533	26.8620
0.0566	27.1800
0.0600	28.2260
0.0633	28.6080
0.0666	28.7340
0.0700	29.2410
0.0733	29.2410
0.0766	29.7800
0.0800	30.3200
0.0833	30.6690
0.0866	31.1770
0.0900	31.3680
0.0933	31.6540
0.0966	32.1290
0.1000	32.4790
0.1033	32.8580
0.1066	33.1440
0.1100	33.5250
0.1133	33.9370
0.1166	34.2860
0.1200	34.6990
0.1233	35.1110
0.1266	35.3650
0.1300	35.5860
0.1333	35.7460
0.1366	36.3170
0.1400	36.5390
0.1433	36.9830
0.1466	37.3320
0.1500	37.5210
0.1533	38.0290
0.1566	38.2200
0.1600	38.5680
0.1633	38.8230
0.1666	37.5530
0.1700	37.7130
0.1733	37.4590
0.1766	36.8880

0.1800	37.7750
0.1833	37.5850
0.1866	37.6490
0.1900	37.3950
0.1933	37.8710
0.1966	37.7750
0.2000	37.8710
0.2033	38.1890
0.2066	38.1250
0.2100	38.1890
0.2133	38.1570
0.2166	38.6320
0.2200	38.4420
0.2233	38.3460
0.2266	38.5680
0.2300	38.6960
0.2333	38.4420
0.2366	38.9170
0.2400	38.7590
0.2433	38.9490
0.2466	38.6320
0.2500	39.1090
0.2533	38.9810
0.2566	38.9810
0.2600	39.1390
0.2633	39.3620
0.2666	39.1710
0.2700	39.2350
0.2733	39.2990
0.2766	39.3940
0.2800	39.4880
0.2833	39.4880
0.2866	39.5520
0.2900	39.6150
0.2933	39.5830
0.2966	39.1710
0.3000	39.7100
0.3033	39.7730
0.3066	39.9330
0.3100	39.8370
0.3133	39.9950
0.3166	39.8370
0.3200	40.1860
0.3233	40.2810
0.3266	40.2810
0.3300	39.9950
0.3333	40.2180
0.3500	40.5980
0.3666	40.9470
0.3833	41.1690
0.4000	41.6120
0.4166	41.8040
0.4333	41.9940
0.4500	42.0250
0.4666	42.5640
0.4833	42.6920
0.5000	42.9760
0.5166	43.3250
0.5333	43.7060
0.5500	43.6110

0.5666	44.0560
0.5833	44.1820
0.6000	44.6250
0.6166	44.9100
0.6333	44.9420
0.6500	45.2280
0.6666	45.5130
0.6833	45.7040
0.7000	45.8630
0.7166	46.0840
0.7333	46.4010
0.7500	46.5290
0.7666	46.8770
0.7833	47.2890
0.8000	47.2260
0.8166	47.9860
0.8333	47.4470
0.8500	47.8600
0.8666	47.9860
0.8833	48.3350
0.9000	48.3350
0.9166	48.6850
0.9333	48.7160
0.9500	49.2240
0.9666	49.5090
0.9833	49.2240
1.0000	49.6990
1.2000	52.1710
1.4000	54.2640
1.6000	56.2920
1.8000	58.1940
2.0000	60.0640
2.2000	61.8070
2.4000	63.7080
2.6000	65.6720
2.8000	67.6050
3.0000	69.4740
3.2000	70.9950
3.4000	72.5150
3.6000	74.1620
3.8000	76.2210
4.0000	77.6780
4.2000	78.7230
4.4000	80.0530
4.6000	81.0030
4.8000	81.9530
5.0000	83.0290
5.2000	83.7570
5.4000	85.0550
5.6000	85.4980
5.8000	85.7200
6.0000	86.5740
6.2000	86.8590
6.4000	87.1130
6.6000	87.4610
6.8000	88.1250
7.0000	89.1380
7.2000	90.1510
7.4000	90.7840
7.6000	91.4170

7.8000	91.9870
8.0000	92.5570
8.2000	93.3170
8.4000	93.6960
8.6000	93.9810
8.8000	94.6460
9.0000	94.9620
9.2000	95.4370
9.4000	95.6590
9.6000	96.0380
9.8000	96.3230
10.0000	96.6390
11.0000	97.3670
12.0000	99.1070
13.0000	100.5320
14.0000	101.6070
15.0000	102.2720
16.0000	102.5880
17.0000	103.0310
18.0000	102.8730
19.0000	103.3470
20.0000	103.6010
21.0000	105.3720
22.0000	107.2700
23.0000	108.1240
24.0000	109.1680
25.0000	109.4520
26.0000	109.9270
27.0000	109.4520
28.0000	107.8710
29.0000	108.9780
30.0000	110.6540
31.0000	112.0140
32.0000	112.7090
33.0000	113.2470
34.0000	113.6270
35.0000	113.5630
36.0000	113.6900
37.0000	113.8170
38.0000	113.5630
39.0000	113.7220
40.0000	113.6270
41.0000	113.3740
42.0000	113.6580
43.0000	113.5950
44.0000	113.5000
45.0000	113.4370
46.0000	112.6150
47.0000	112.2670
48.0000	112.1720
49.0000	111.9510
50.0000	111.8560
51.0000	111.7610
52.0000	111.7290
53.0000	112.0140
54.0000	111.6980
55.0000	111.6660
56.0000	111.6350
57.0000	111.6350
58.0000	111.9190

59.0000	111.9190
60.0000	112.8360
61.0000	114.8280
62.0000	116.3460
63.0000	117.2630
64.0000	117.9270
65.0000	118.2750
66.0000	118.9070
67.0000	118.8440
68.0000	119.3810
69.0000	119.2550
70.0000	119.1600
71.0000	119.5710
72.0000	119.9820
73.0000	119.9510
74.0000	120.2030
75.0000	120.4560
76.0000	120.6780
77.0000	120.5190

I-13
ZONE 1500-1560
RECOVERY DATA

TIME	WATER LEVEL
0.0000	116.0930
0.0033	116.9150
0.0066	117.7690
0.0100	120.2980
0.0133	120.2030
0.0166	120.2030
0.0200	118.9390
0.0233	119.6340
0.0266	119.7600
0.0300	119.0970
0.0333	119.3810
0.0366	118.0540
0.0400	118.4960
0.0433	118.0220
0.0466	118.3700
0.0500	118.2430
0.0533	118.0220
0.0566	117.8640
0.0600	117.3580
0.0633	117.4840
0.0666	117.5160
0.0700	116.8840
0.0733	116.9780
0.0766	116.8520
0.0800	116.7570
0.0833	116.4730
0.0866	115.9980
0.0900	115.8400
0.0933	115.6500
0.0966	115.7460
0.1000	115.4920
0.1033	115.4920
0.1066	115.1760
0.1100	114.7330
0.1133	114.8600
0.1166	114.4810
0.1200	114.6700
0.1233	114.3860
0.1266	114.3540
0.1300	114.1960
0.1333	113.5950
0.1366	113.7530
0.1400	113.6270
0.1433	113.4060
0.1466	112.9000
0.1500	113.0260
0.1533	112.9940
0.1566	112.7730
0.1600	112.6460
0.1633	112.5830
0.1666	111.9820
0.1700	112.1400
0.1733	111.7930
0.1766	111.7290

0.1800	111.5080
0.1833	111.2860
0.1866	111.1280
0.1900	111.0970
0.1933	111.0340
0.1966	110.6540
0.2000	110.6230
0.2033	110.3060
0.2066	110.4330
0.2100	110.5590
0.2133	109.8950
0.2166	109.9270
0.2200	109.6420
0.2233	109.4520
0.2266	109.1040
0.2300	109.1040
0.2333	108.9780
0.2366	108.9780
0.2400	108.4710
0.2433	108.3770
0.2466	108.3140
0.2500	108.2500
0.2533	107.8390
0.2566	107.9030
0.2600	107.3960
0.2633	107.3650
0.2666	107.3010
0.2700	107.2700
0.2733	106.7640
0.2766	106.8590
0.2800	106.6050
0.2833	106.4480
0.2866	107.5230
0.2900	106.3530
0.2933	106.3530
0.2966	105.8780
0.3000	105.6570
0.3033	105.4990
0.3066	105.8780
0.3100	105.2140
0.3133	105.2460
0.3166	104.9290
0.3200	104.5810
0.3233	105.1820
0.3266	104.4230
0.3300	104.3910
0.3333	103.9480
0.3500	103.3160
0.3666	102.3980
0.3833	101.5120
0.4000	100.6580
0.4166	99.8990
0.4333	99.4240
0.4500	97.7470
0.4666	97.3350
0.4833	96.3540
0.5000	95.5320
0.5166	94.8360
0.5333	93.9810
0.5500	92.9370

0.5666	92.3030
0.5833	91.6390
0.6000	90.8160
0.6166	89.9610
0.6333	89.0440
0.6500	88.2840
0.6666	87.1440
0.6833	86.6690
0.7000	85.9730
0.7166	84.9280
0.7333	84.0420
0.7500	83.4720
0.7666	82.8390
0.7833	81.7310
0.8000	81.3200
0.8166	80.5280
0.8333	79.6090
0.8500	78.6280
0.8666	78.0890
0.8833	77.3610
0.9000	76.5690
0.9166	75.8730
0.9333	75.2080
0.9500	74.4160
0.9666	73.5600
0.9833	72.8640
1.0000	72.1670
1.2000	61.9020
1.4000	54.3590
1.6000	47.0040
1.8000	40.3760
2.0000	20.1330
2.2000	1.7480
2.4000	-0.8560
2.6000	-1.1420
2.8000	-0.5070
3.0000	-0.7620
3.2000	-0.8260
3.4000	-0.7940
3.6000	-0.8880
3.8000	-0.8560
4.0000	-0.8880
4.2000	-0.8560
4.4000	-0.8260
4.6000	-0.8560
4.8000	-0.8880
5.0000	-0.8880
5.2000	-0.9520
5.4000	-0.8880
5.6000	-0.9840
5.8000	-0.9520
6.0000	-0.9520
6.2000	-0.9520
6.4000	-0.9200
6.6000	-0.9840
6.8000	-0.9200
7.0000	-0.8880
7.2000	-0.9200
7.4000	-1.0160
7.6000	-0.9200

7.8000	-0.9840
8.0000	-1.0160
8.2000	-0.9840
8.4000	-0.9840
8.6000	-1.0160
8.8000	-0.9840
9.0000	-1.0800
9.2000	-1.0160
9.4000	-1.0160
9.6000	-0.9840
9.8000	-1.0160
10.0000	-1.1110
11.0000	-1.0160
12.0000	-1.1110
13.0000	-1.1110
14.0000	-1.1420
15.0000	-1.1740
16.0000	-1.1420
17.0000	-1.1740
18.0000	-1.2380
19.0000	-1.2380
20.0000	-1.1420
21.0000	-1.1740
22.0000	-1.2060
23.0000	-1.2380
24.0000	-1.1740
25.0000	-1.2060
26.0000	-1.2700
27.0000	-1.2700
28.0000	-1.3020
29.0000	-1.2380
30.0000	-1.3020
31.0000	-1.2700
32.0000	-1.3020
33.0000	-1.3340
34.0000	-1.3340
35.0000	-1.2700
36.0000	-1.3660
37.0000	-1.3340
38.0000	-1.3660
39.0000	-1.3660
40.0000	-1.3660
41.0000	-1.3660
42.0000	-1.4280
43.0000	-1.3340
44.0000	-1.3960
45.0000	-1.3960
46.0000	-1.3960
47.0000	-1.3960
48.0000	-1.3660
49.0000	-1.3660
50.0000	-1.3960
51.0000	-1.4600
52.0000	-1.3960
53.0000	-1.4280
54.0000	-1.4280
55.0000	-1.3960
56.0000	-1.4280
57.0000	-1.4280
58.0000	-1.4600

59.0000	-1.4280
60.0000	-1.4280
61.0000	-1.4280
62.0000	-1.4920
63.0000	-1.4600

I-13
ZONE 1750-1810
BACKGROUND DATA

TIME	WATER LEVEL
0.0000	93.609
0.0033	93.641
0.0066	93.577
0.0100	93.545
0.0133	93.545
0.0166	93.545
0.0200	93.609
0.0233	93.609
0.0266	93.577
0.0300	93.514
0.0333	93.545
0.0366	93.577
0.0400	93.609
0.0433	93.609
0.0466	93.577
0.0500	93.451
0.0533	93.545
0.0566	93.673
0.0600	93.545
0.0633	93.577
0.0666	93.545
0.0700	93.705
0.0733	93.609
0.0766	93.705
0.0800	93.514
0.0833	93.609
0.0866	93.609
0.0900	93.705
0.0933	93.609
0.0966	93.545
0.1000	93.609
0.1033	93.577
0.1066	93.609
0.1100	93.545
0.1133	93.609
0.1166	93.609
0.1200	93.545
0.1233	93.577
0.1266	93.609
0.1300	93.641
0.1333	93.577
0.1366	93.577
0.1400	93.545
0.1433	93.545
0.1466	93.545
0.1500	93.673
0.1533	93.483
0.1566	93.577
0.1600	93.577
0.1633	93.545
0.1666	93.609
0.1700	93.514
0.1733	93.577
0.1766	93.545

0.1800	93.545
0.1833	93.545
0.1866	93.545
0.1900	93.577
0.1933	93.609
0.1966	93.545
0.2000	93.483
0.2033	93.641
0.2066	93.483
0.2100	93.609
0.2133	93.737
0.2166	93.514
0.2200	93.577
0.2233	93.514
0.2266	93.577
0.2300	93.641
0.2333	93.545
0.2366	93.545
0.2400	93.577
0.2433	93.577
0.2466	93.577
0.2500	93.609
0.2533	93.545
0.2566	93.577
0.2600	93.545
0.2633	93.514
0.2666	93.609
0.2700	93.577
0.2733	93.577
0.2766	93.577
0.2800	93.514
0.2833	93.609
0.2866	93.545
0.2900	93.609
0.2933	93.609
0.2966	93.514
0.3000	93.577
0.3033	93.577
0.3066	93.545
0.3100	93.705
0.3133	93.609
0.3166	93.577
0.3200	93.577
0.3233	93.577
0.3266	93.673
0.3300	93.609
0.3333	93.577
0.3500	93.577
0.3666	93.609
0.3833	93.641
0.4000	93.577
0.4166	93.673
0.4333	93.577
0.4500	93.577
0.4666	93.577
0.4833	93.609
0.5000	93.609
0.5166	93.609
0.5333	93.577
0.5500	93.577

0.5666	93.577
0.5833	93.514
0.6000	93.545
0.6166	93.514
0.6333	93.545
0.6500	93.577
0.6666	93.514
0.6833	93.577
0.7000	93.545
0.7166	93.577
0.7333	93.545
0.7500	93.545
0.7666	93.514
0.7833	93.545
0.8000	93.577
0.8166	93.577
0.8333	93.609
0.8500	93.545
0.8666	93.577
0.8833	93.609
0.9000	93.609
0.9166	93.577
0.9333	93.545
0.9500	93.577
0.9666	93.545
0.9833	93.577
1.0000	93.545
1.2000	93.545
1.4000	93.609
1.6000	93.577
1.8000	93.545
2.0000	93.545
2.2000	93.514
2.4000	93.514
2.6000	93.514
2.8000	93.483
3.0000	93.514
3.2000	93.451
3.4000	93.545
3.6000	93.514
3.8000	93.451
4.0000	93.514
4.2000	93.483
4.4000	93.514
4.6000	93.451
4.8000	93.483
5.0000	93.451
5.2000	93.483
5.4000	93.451
5.6000	93.451
5.8000	93.451
6.0000	93.451
6.2000	93.419
6.4000	93.419
6.6000	93.419
6.8000	93.451
7.0000	93.419
7.2000	93.451
7.4000	93.451
7.6000	93.356

7.8000	93.483
8.0000	93.419
8.2000	93.419
8.4000	93.419
8.6000	93.419
8.8000	93.419
9.0000	93.387
9.2000	93.419
9.4000	93.419
9.6000	93.419
9.8000	93.419
10.0000	93.387
11.0000	93.387
12.0000	93.356
13.0000	93.356
14.0000	93.356
15.0000	93.323
16.0000	93.323
17.0000	93.356
18.0000	93.323
19.0000	93.356
20.0000	93.356
21.0000	93.292
22.0000	93.292
23.0000	93.292
24.0000	93.356
25.0000	93.292
26.0000	93.323
27.0000	93.228
28.0000	93.228
29.0000	93.228
30.0000	93.228
31.0000	93.228
32.0000	93.197
33.0000	93.197
34.0000	93.166
35.0000	93.197
36.0000	93.166
37.0000	93.166
38.0000	93.134
39.0000	93.166
40.0000	93.134
41.0000	93.134
42.0000	93.102
43.0000	93.102
44.0000	93.102
45.0000	93.070
46.0000	93.070
47.0000	93.102
48.0000	93.070
49.0000	93.038
50.0000	93.070
51.0000	93.070
52.0000	93.070
53.0000	93.070
54.0000	93.070
55.0000	93.038
56.0000	93.070
57.0000	93.038
58.0000	93.038

59.0000	93.038
60.0000	93.038
61.0000	93.038
62.0000	93.038
63.0000	93.006
64.0000	93.006
65.0000	92.974
66.0000	93.006
67.0000	93.006
68.0000	92.974
69.0000	92.974
70.0000	92.974

I-13
ZONE 1750-1810
DRAWDOWN TEST DATA

TIME	WATER LEVEL
0.0000	120.9420
0.0033	121.0370
0.0066	121.2580
0.0100	124.3320
0.0133	124.2690
0.0166	122.9700
0.0200	122.8750
0.0233	124.3320
0.0266	114.0320
0.0300	111.1780
0.0333	111.1460
0.0366	111.2100
0.0400	115.7120
0.0433	110.8310
0.0466	111.4640
0.0500	111.6230
0.0533	113.2400
0.0566	111.1150
0.0600	111.9390
0.0633	112.1300
0.0666	111.8760
0.0700	110.7030
0.0733	113.1440
0.0766	112.9230
0.0800	112.5740
0.0833	112.3840
0.0866	113.4290
0.0900	113.5250
0.0933	113.2400
0.0966	113.7790
0.1000	114.4440
0.1033	113.7460
0.1066	113.8420
0.1100	114.4130
0.1133	114.6030
0.1166	114.2860
0.1200	114.5390
0.1233	115.0460
0.1266	114.9200
0.1300	114.8880
0.1333	115.2370
0.1366	115.4900
0.1400	115.3630
0.1433	115.7750
0.1466	116.0610
0.1500	115.9340
0.1533	115.8390
0.1566	116.1560
0.1600	116.3780
0.1633	116.3140
0.1666	116.5040
0.1700	116.7580
0.1733	116.6950
0.1766	116.8530

0.1800	117.1070
0.1833	117.3600
0.1866	117.2650
0.1900	117.3600
0.1933	117.7720
0.1966	117.9620
0.2000	117.9620
0.2033	118.1520
0.2066	118.4060
0.2100	118.3430
0.2133	118.4380
0.2166	118.6600
0.2200	118.9130
0.2233	118.8820
0.2266	119.1350
0.2300	119.1670
0.2333	119.2620
0.2366	119.4520
0.2400	119.6420
0.2433	119.8010
0.2466	119.8320
0.2500	119.8960
0.2533	120.1500
0.2566	120.2760
0.2600	120.3710
0.2633	120.6250
0.2666	120.6570
0.2700	120.7200
0.2733	120.7200
0.2766	121.0690
0.2800	121.2270
0.2833	121.3220
0.2866	121.5120
0.2900	121.5440
0.2933	121.5440
0.2966	121.8600
0.3000	121.9240
0.3033	122.1140
0.3066	122.0510
0.3100	122.3360
0.3133	122.4310
0.3166	122.6840
0.3200	122.6840
0.3233	122.7160
0.3266	123.0650
0.3300	123.2230
0.3333	123.2870
0.3500	124.0150
0.3666	124.6170
0.3833	125.3780
0.4000	125.9480
0.4166	126.7090
0.4333	127.5010
0.4500	128.0400
0.4666	128.7360
0.4833	129.3700
0.5000	129.7500
0.5166	130.6690
0.5333	131.1120
0.5500	131.6820

0.5666	132.1260
0.5833	133.0450
0.6000	133.4880
0.6166	134.2800
0.6333	134.7550
0.6500	135.3570
0.6666	135.8640
0.6833	136.4660
0.7000	137.1310
0.7166	137.7320
0.7333	138.2390
0.7500	138.8410
0.7666	139.5060
0.7833	140.1070
0.8000	140.4870
0.8166	140.9620
0.8333	141.5960
0.8500	142.1660
0.8666	142.5140
0.8833	143.1150
0.9000	143.6850
0.9166	144.2550
0.9333	144.6040
0.9500	145.1730
0.9666	145.7440
0.9833	146.0920
1.0000	146.7880
1.2000	153.8150
1.4000	159.1000
1.6000	163.6250
1.8000	167.7370
2.0000	171.4690
2.2000	175.1690
2.4000	178.7740
2.6000	181.5880
2.8000	184.6220
3.0000	187.1190
3.2000	189.6480
3.4000	191.8920
3.6000	194.1670
3.8000	196.2520
4.0000	197.9270
4.2000	199.7270
4.4000	201.4960
4.6000	202.9810
4.8000	204.4340
5.0000	205.5710
5.2000	207.0240
5.4000	208.4450
5.6000	209.4550
5.8000	210.2130
6.0000	211.5080
6.2000	212.3600
6.4000	213.1180
6.6000	214.0970
6.8000	214.9490
7.0000	215.6430
7.2000	216.3380
7.4000	217.0010
7.6000	217.8220

7.8000	218.4530
8.0000	219.1790
8.2000	219.7790
8.4000	220.3790
8.6000	220.9470
8.8000	221.4830
9.0000	222.1140
9.2000	222.4620
9.4000	223.0300
9.6000	223.2510
9.8000	223.8190
10.0000	224.1340
11.0000	225.5860
12.0000	226.0590
13.0000	227.1640
14.0000	227.4790
15.0000	227.7950
16.0000	228.1110
17.0000	228.1420
18.0000	228.2680
19.0000	228.5520
20.0000	228.4260
21.0000	228.7100
22.0000	228.8360
23.0000	228.8050
24.0000	228.8680
25.0000	229.1200
26.0000	229.3100
27.0000	229.4040
28.0000	229.2780
29.0000	229.3410
30.0000	229.3730
31.0000	229.2780
32.0000	229.6570
33.0000	229.7830
34.0000	229.5930
35.0000	229.8460
36.0000	230.0350
37.0000	229.9090
38.0000	229.9720
39.0000	229.8770
40.0000	229.9090
41.0000	230.0670
42.0000	230.1300
43.0000	230.0040
44.0000	230.0980
45.0000	230.0980
46.0000	230.2880
47.0000	230.0670
48.0000	230.2560
49.0000	230.2560
50.0000	230.1930
51.0000	230.2560
52.0000	230.1930
53.0000	230.1610
54.0000	230.1300
55.0000	230.0980
56.0000	230.2240
57.0000	230.1930
58.0000	230.2560

59.0000	230.2880
60.0000	230.2240
61.0000	230.4770
62.0000	230.4770
63.0000	230.7610
64.0000	230.6660
65.0000	230.5720

I-13
ZONE 1750-1810
RECOVERY DATA

TIME	WATER LEVEL
0.0000	170.008
0.0033	169.093
0.0066	168.903
0.0100	169.661
0.0133	169.787
0.0166	169.566
0.0200	169.250
0.0233	168.840
0.0266	168.588
0.0300	168.462
0.0333	167.831
0.0366	168.115
0.0400	167.862
0.0433	167.957
0.0466	167.515
0.0500	167.578
0.0533	167.452
0.0566	167.231
0.0600	167.294
0.0633	167.042
0.0666	166.789
0.0700	166.505
0.0733	166.442
0.0766	166.190
0.0800	166.001
0.0833	165.906
0.0866	166.064
0.0900	165.811
0.0933	165.432
0.0966	165.401
0.1000	165.243
0.1033	165.085
0.1066	164.928
0.1100	164.517
0.1133	164.581
0.1166	164.328
0.1200	164.265
0.1233	163.981
0.1266	164.012
0.1300	163.697
0.1333	163.602
0.1366	163.350
0.1400	163.255
0.1433	163.066
0.1466	162.971
0.1500	162.813
0.1533	162.624
0.1566	162.435
0.1600	162.214
0.1633	162.245
0.1666	162.087
0.1700	161.961
0.1733	161.709
0.1766	161.772

0.1800	161.393
0.1833	161.393
0.1866	161.109
0.1900	160.920
0.1933	160.983
0.1966	160.699
0.2000	160.509
0.2033	160.383
0.2066	160.225
0.2100	160.162
0.2133	160.162
0.2166	159.657
0.2200	159.594
0.2233	159.436
0.2266	159.310
0.2300	159.184
0.2333	159.089
0.2366	158.868
0.2400	158.805
0.2433	158.521
0.2466	158.363
0.2500	158.363
0.2533	158.173
0.2566	157.953
0.2600	157.732
0.2633	157.700
0.2666	157.669
0.2700	157.258
0.2733	157.258
0.2766	157.006
0.2800	156.816
0.2833	156.753
0.2866	156.595
0.2900	156.374
0.2933	156.438
0.2966	156.343
0.3000	155.964
0.3033	155.996
0.3066	155.649
0.3100	155.712
0.3133	155.364
0.3166	155.364
0.3200	155.112
0.3233	154.985
0.3266	154.764
0.3300	154.670
0.3333	154.575
0.3500	153.659
0.3666	152.933
0.3833	152.175
0.4000	151.386
0.4166	150.502
0.4333	149.776
0.4500	149.081
0.4666	148.197
0.4833	147.755
0.5000	146.586
0.5166	146.081
0.5333	145.197
0.5500	144.565

0.5666	143.650
0.5833	142.986
0.6000	142.260
0.6166	141.375
0.6333	140.933
0.6500	140.175
0.6666	139.607
0.6833	138.975
0.7000	138.185
0.7166	137.522
0.7333	136.890
0.7500	136.289
0.7666	135.468
0.7833	134.931
0.8000	134.109
0.8166	133.509
0.8333	132.940
0.8500	132.245
0.8666	131.581
0.8833	130.918
0.9000	130.254
0.9166	129.685
0.9333	129.022
0.9500	128.358
0.9666	127.758
0.9833	127.094
1.0000	126.620
1.2000	117.674
1.4000	110.338
1.6000	103.569
1.8000	97.399
2.0000	91.291
2.2000	85.625
2.4000	80.275
2.6000	75.397
2.8000	70.710
3.0000	66.528
3.2000	62.757
3.4000	59.176
3.6000	56.071
3.8000	53.155
4.0000	50.713
4.2000	43.770
4.4000	39.520
4.6000	38.917
4.8000	38.600
5.0000	38.346
5.2000	38.157
5.4000	37.998
5.6000	37.871
5.8000	37.743
6.0000	37.649
6.2000	37.521
6.4000	37.427
6.6000	37.332
6.8000	37.236
7.0000	37.174
7.2000	37.078
7.4000	37.014
7.6000	36.951

7.8000	36.888
8.0000	36.825
8.2000	36.761
8.4000	36.697
8.6000	36.665
8.8000	36.603
9.0000	36.539
9.2000	36.507
9.4000	36.443
9.6000	36.411
9.8000	36.349
10.0000	36.317
11.0000	36.126
12.0000	35.936
13.0000	35.778
14.0000	35.618
15.0000	35.524
16.0000	35.397
17.0000	35.301
18.0000	35.175
19.0000	35.079
20.0000	35.016
21.0000	34.921
22.0000	34.857
23.0000	34.762
24.0000	34.730
25.0000	34.636
26.0000	34.572
27.0000	34.508
28.0000	34.476
29.0000	34.414
30.0000	34.350
31.0000	34.318
32.0000	34.255
33.0000	34.223
34.0000	34.191
35.0000	34.128
36.0000	34.096
37.0000	34.065
38.0000	34.033
39.0000	34.001
40.0000	33.969
41.0000	33.937
42.0000	33.937
43.0000	33.875
44.0000	33.843
45.0000	33.843
46.0000	33.811
47.0000	33.779
48.0000	33.747
49.0000	33.747
50.0000	33.715
51.0000	33.683
52.0000	33.652
53.0000	33.652
54.0000	33.619
55.0000	33.589
56.0000	33.557
57.0000	33.557
58.0000	33.525

59.0000	33.525
60.0000	33.494
61.0000	33.494
62.0000	33.462