

Karin

MEMORANDUM

TO: Walter Ward, Water Use Division, Resource Control Dept.
FROM: Wm. Scott Burns, Hydrogeology Division, Resource Planning Dept. WSB
DATE: May 14, 1987
SUBJECT: Review of the Hydrogeologic Study for Walter Ferguson

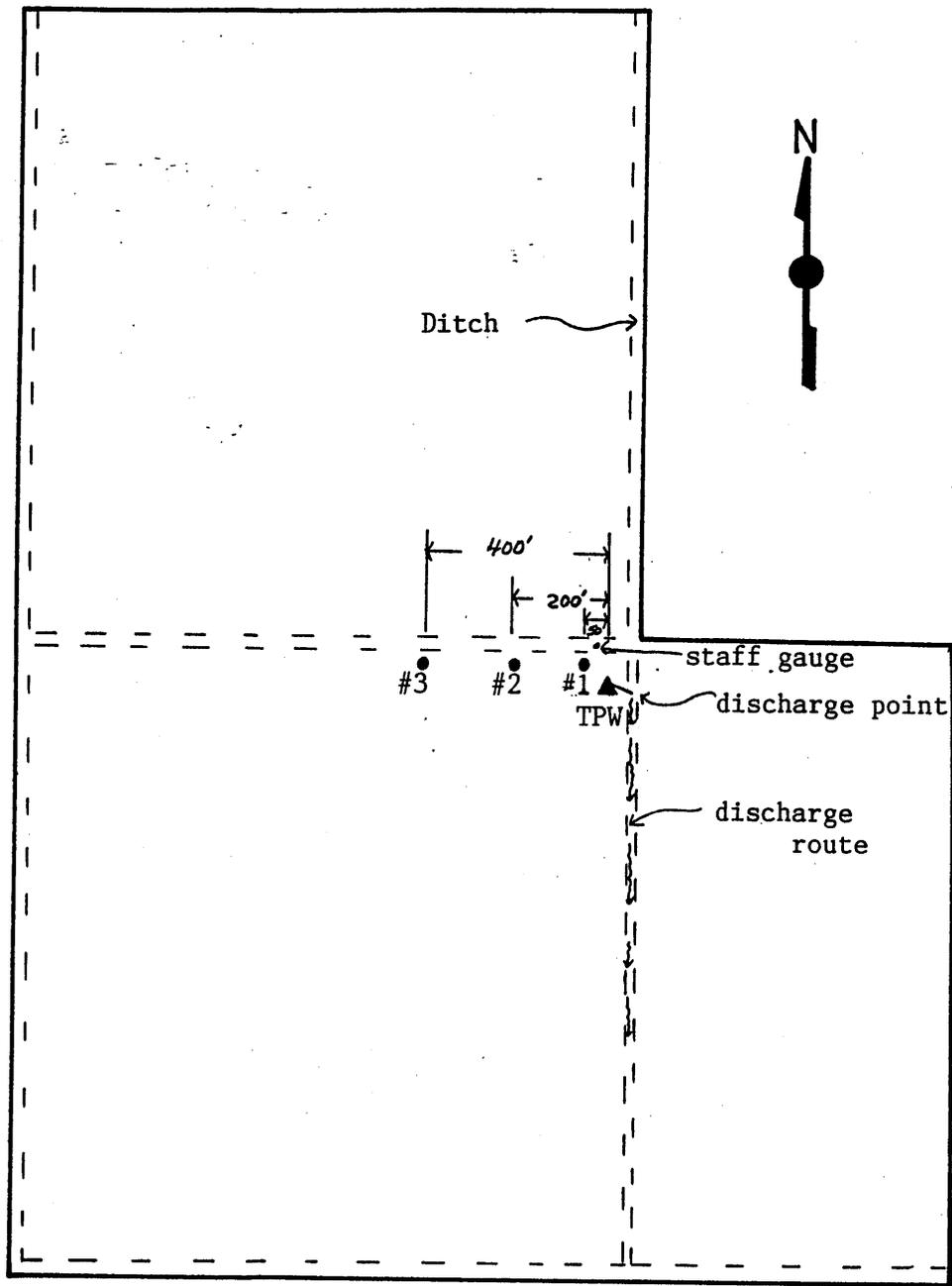
Upon review of the subject report, it became evident that during the pump test boundary conditions were encountered as the consultant points out. Review of other aquifer tests in the area indicates rather uniform transmissivities which range between 10,000 and 30,000 gpd/ft. Further, the nature of the depositional environment in the upper portion of the Hawthorn Group suggests the coarse sand facies, which the production well penetrates, is most likely a channel fill feature and very localized in its areal extent. Therefore, when assessing long term impacts of pumping, it is recommended that the late time data be used to determine the aquifer coefficients. It is apparent that the test was not run long enough to reach steady state conditions after the boundary effects were encountered. This makes interpretation of the data with respect to storage and leakance rather tenuous. Rough analysis of the late time data gives a transmissivity value of approximately 20,000 gpd/ft. Using storage and leakance data from other tests in the area, representative values for these parameters are .001 and .002 gpd/ft³ respectively.

Also, note the chloride data presented in the report. Unusually high chloride levels occur throughout this region of southwestern Glades and northwestern Hendry counties. It is possible that chlorides will increase with use and the implications of this, with respect to other users, should be reviewed.

With respect to the name of the aquifer which is being tapped, it hasn't got one. Monitor wells for this unit indicate a north to south flow gradient and lithologic data suggests a limited areal extent within a few miles along the Caloosahatchee River. While there are a number of users in the area which tap this source, they are not impacting either the sandstone or the lower Tamiami aquifers. A name (perhaps the Caloosahatchee aquifer) and a map of its areal extent is forthcoming in the Glades/Hendry study.

WSB:hm

cc: S. Trost
Karin Nelms ✓
Keith Smith



SCALE: 1 inch = 400 feet
 DATE: April 1987

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Figure 5: Test Set-up

Table 1

Well Descriptions

| Well No. | TPW | #1 | #2 | #3 |
|-------------|------|------|------|------|
| Diameter | 12" | 2" | 2" | 2" |
| Cased Depth | 90' | 54' | 54' | 54' |
| Total Depth | 100' | 100' | 100' | 100' |

cone-of-depression encountered the boundary after approximately 100 minutes of pumping, consequently limiting the water being supplied from that locality. Since the cone-of-depression must continue to expand, the water is taken from all the other directions more rapidly, causing the water levels to drop faster than normal. To determine the true aquifer characteristics, only the early test data were used in the calculations. Because of the impervious boundary condition, it is not apparent from the data if there is leakance from other aquifers. However, from other work done in the area, there is leakance which probably comes from above and below the withdrawal aquifer. The plotted test data are presented in Figures 6 through 17, with the calculations for the aquifer characteristics shown on each graph. Also, a summary of the calculated values is presented in Table 2. An average value for each characteristic was determined with the following results:

| | |
|---------------------|------------------------------|
| Transmissivity | = 131,137 gpd/ft |
| Storage coefficient | = 0.0003 |
| Leakance | = 0.0006 gpd/ft ³ |

Based on the geology of the surrounding area, it appears that the sand and gravel unit (100 ft) from which this project is withdrawing, changes to clay and then to limestone in a line towards the northeast. This can be seen in Exhibit 4. If the transition from sand and gravel to clay is gradual, as assumed when constructing the cross-section, the influence of the change would probably occur approximately 5,000 feet northeast of the pumped well. From the current lithologic data available, this boundary seems to trend in a northwest-southeast direction, as shown in Exhibit 3. Future hydrogeologic work in this area should refine the exact location of the boundary.

The water level in the ditch next to the monitoring wells did not change throughout the entire test. During the test there were no rainfall events.

Water quality data was taken at the beginning and end of the test. The following are the results of the analysis:

| | Chloride Conc. | Specific Conductance |
|-----------|----------------|----------------------|
| Beginning | 380 mg/l | 1900 micromhos/cm |
| End | 580 mg/l | 2300 micromhos/cm |

IMPACT ANALYSIS

Projected water level declines in a confined aquifer can be assessed in two ways: assume leakance and use a steady-state model or assume no leakance and use a Theis model. Both models are used to determine the potential impacts of withdrawals for this project. The averaged aquifer characteristics calculated above were used in the models.

Two (2) withdrawal rates, 564,000 gallons per day and 400,000 gallons per day, were used in the models. The 564,000 gallons represents the

LOG-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #1

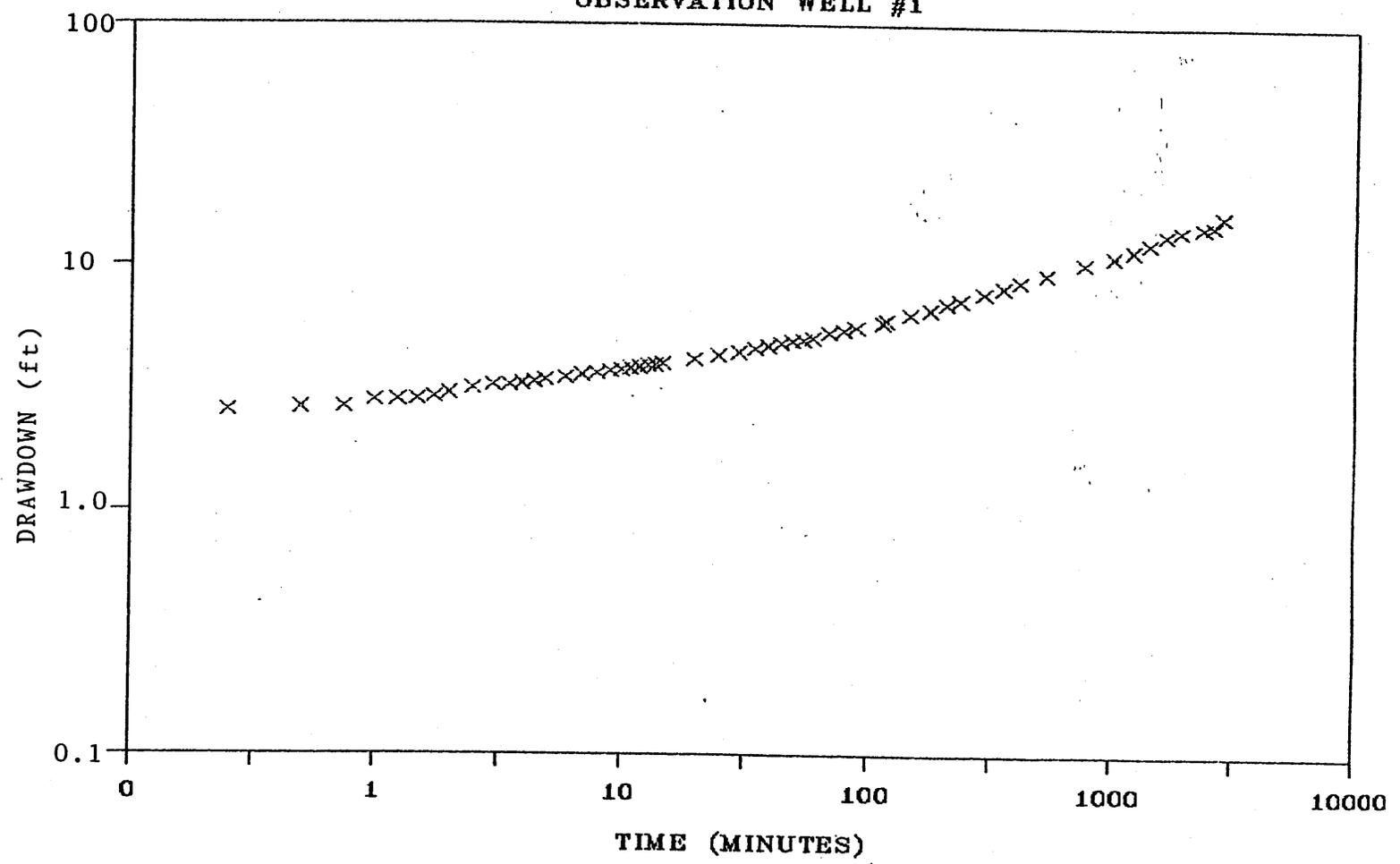


Figure 6: Log-Log Plot of Drawdown vs Time for Observation Well #1

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LOG-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #2

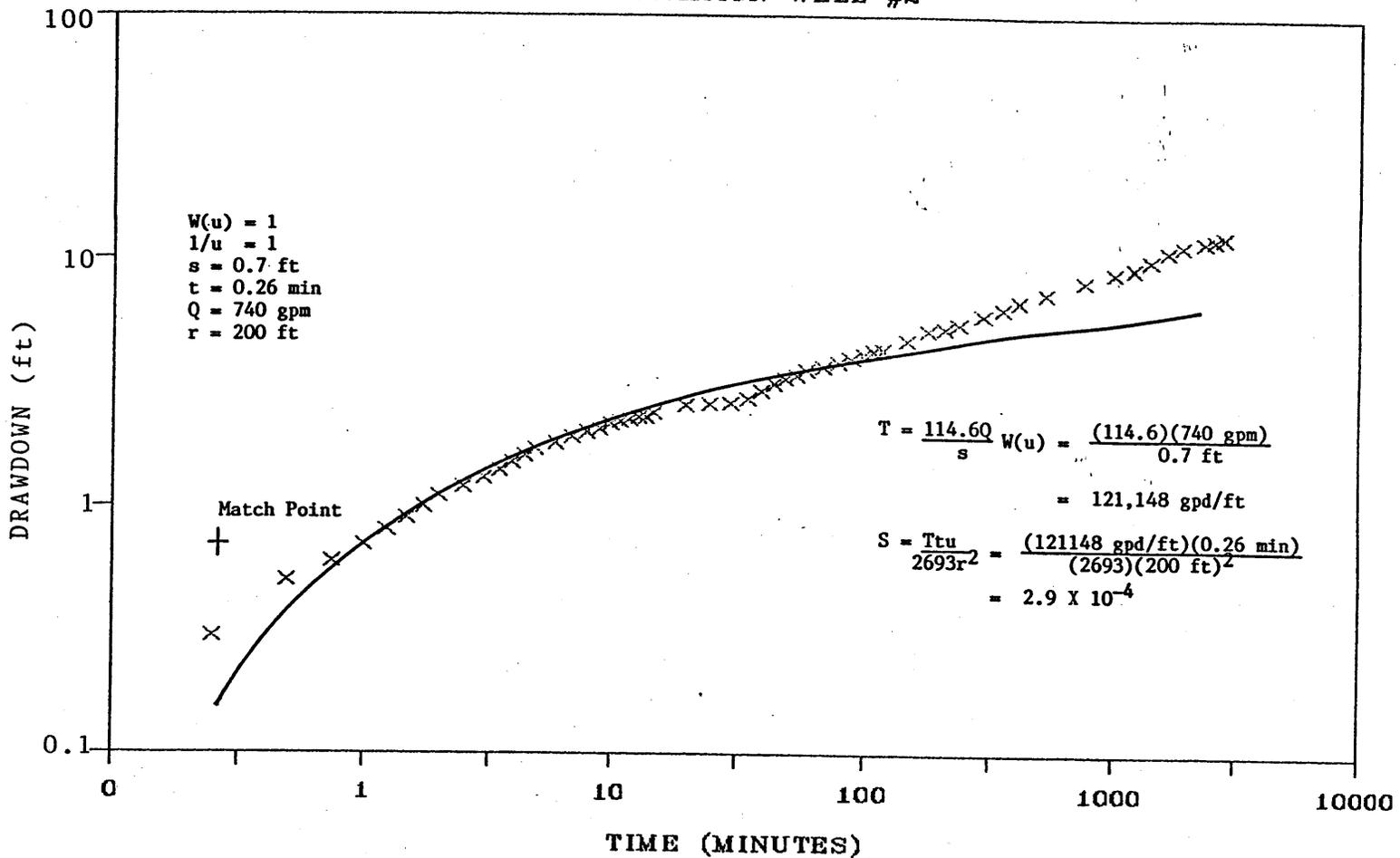


Figure 7: Log-Log Plot of Drawdown vs Time for Observation Well #2

LOG-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #3

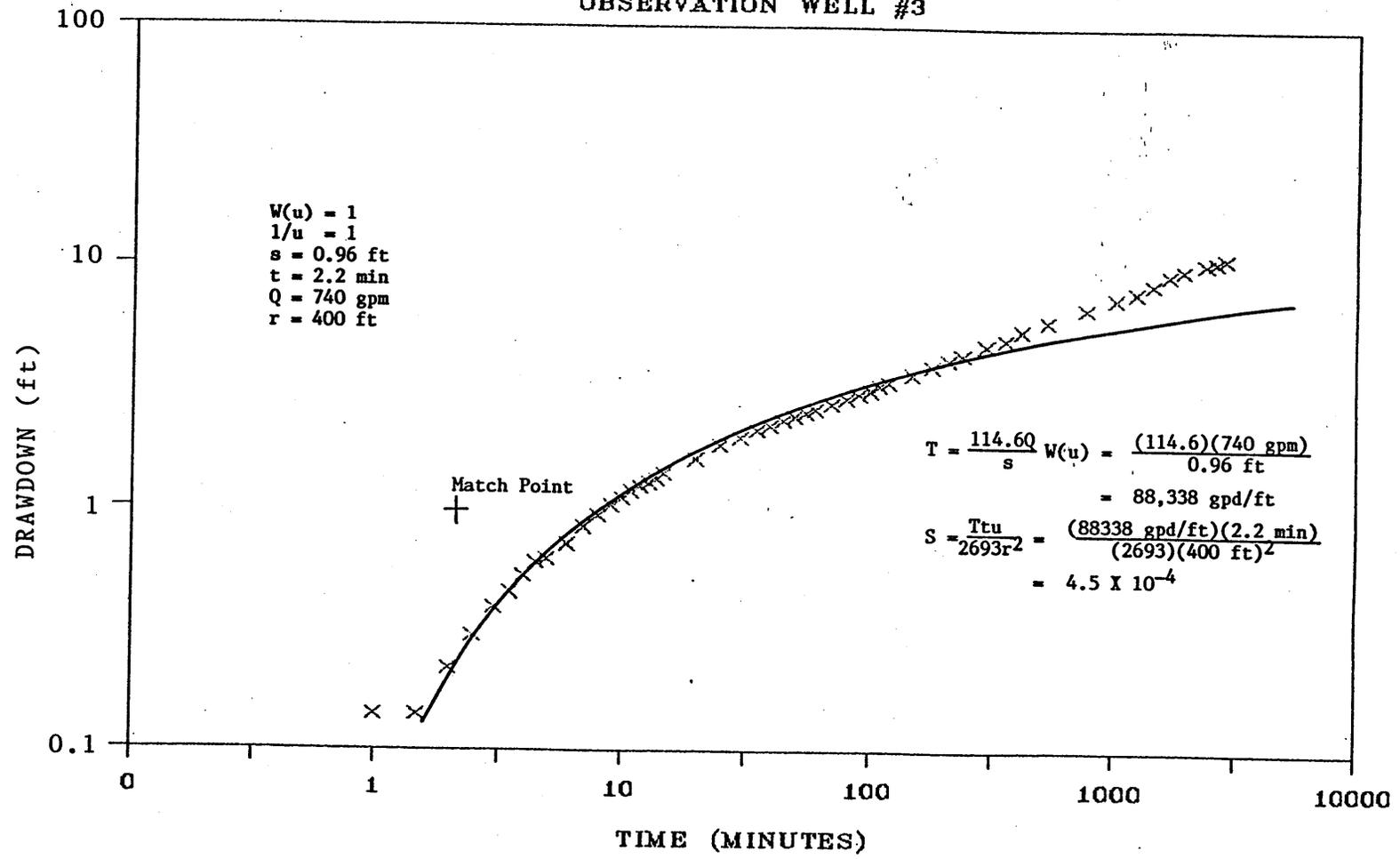


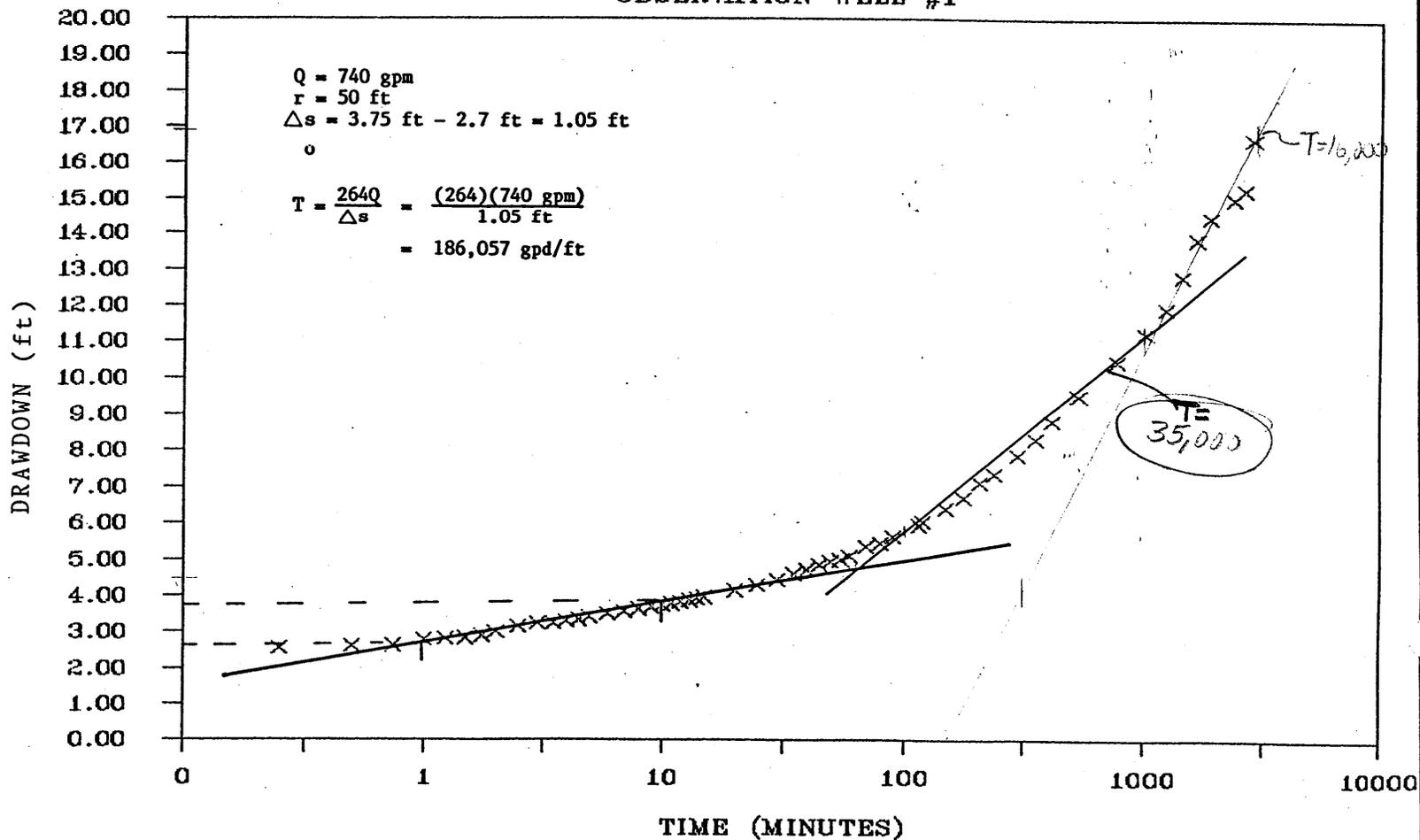
Figure 8: Log-Log Plot of Drawdown vs Time for Observation Well #3

Figure 9: Semi-Log Plot of Drawdown vs Time for Observation Well #1

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SEMI-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #1



SEMI-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #2

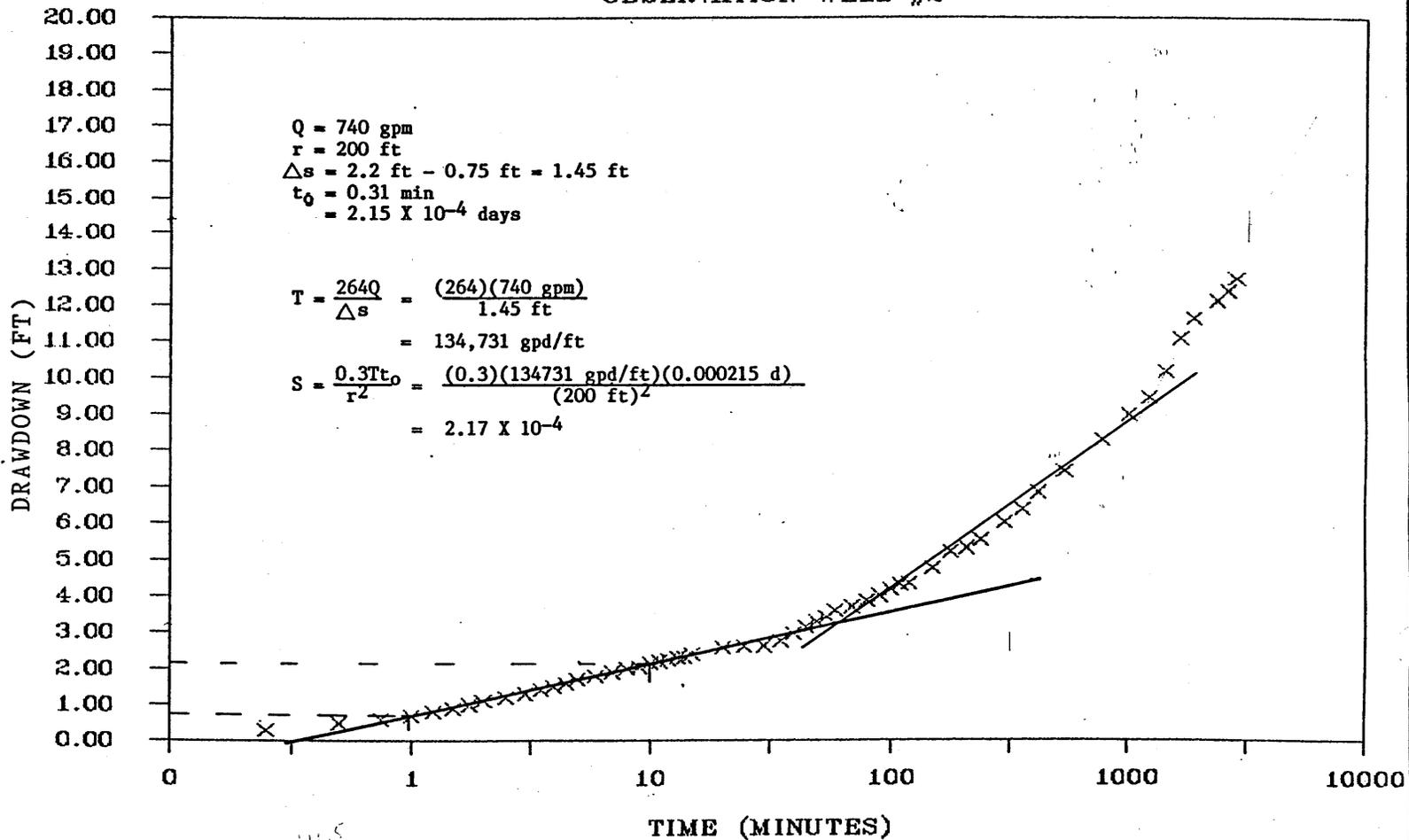


Figure 10: Semi-Log Plot of Drawdown vs Time for Observation Well #2

SEMI-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #3

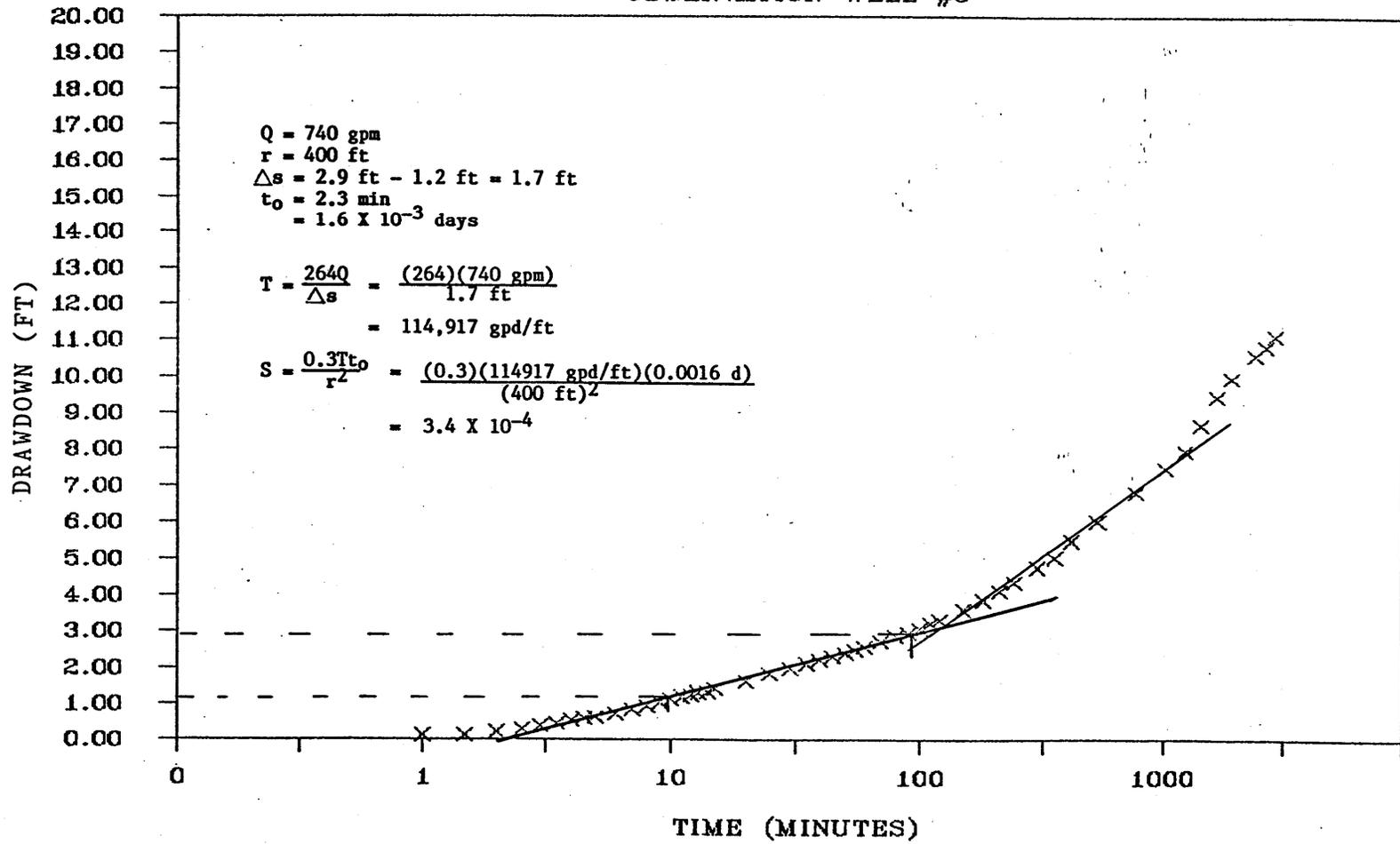
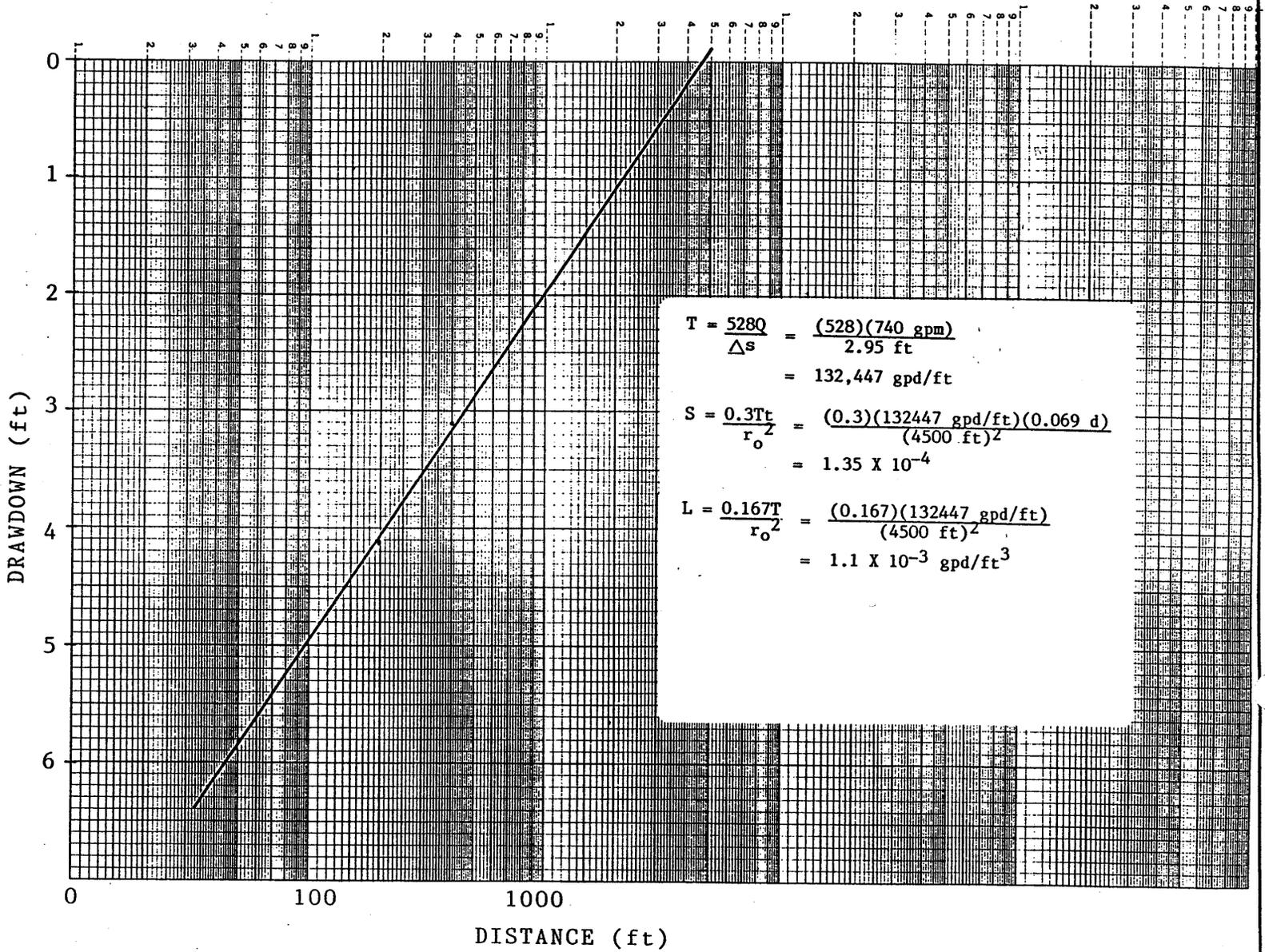


Figure 11: Semi-Log Plot of Drawdown vs Time for Observation Well #3

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DISTANCE - DRAWDOWN



$$T = \frac{528Q}{\Delta s} = \frac{(528)(740 \text{ gpm})}{2.95 \text{ ft}}$$

$$= 132,447 \text{ gpd/ft}$$

$$S = \frac{0.3Tt}{r_o^2} = \frac{(0.3)(132447 \text{ gpd/ft})(0.069 \text{ d})}{(4500 \text{ ft})^2}$$

$$= 1.35 \times 10^{-4}$$

$$L = \frac{0.167T}{r_o^2} = \frac{(0.167)(132447 \text{ gpd/ft})}{(4500 \text{ ft})^2}$$

$$= 1.1 \times 10^{-3} \text{ gpd/ft}^3$$

Figure 12: Distance-Drawdown Plot of all Observation Wells

LOG-LOG PLOT OF DRAWDOWN VS TIME

OBSERVATION WELL #2

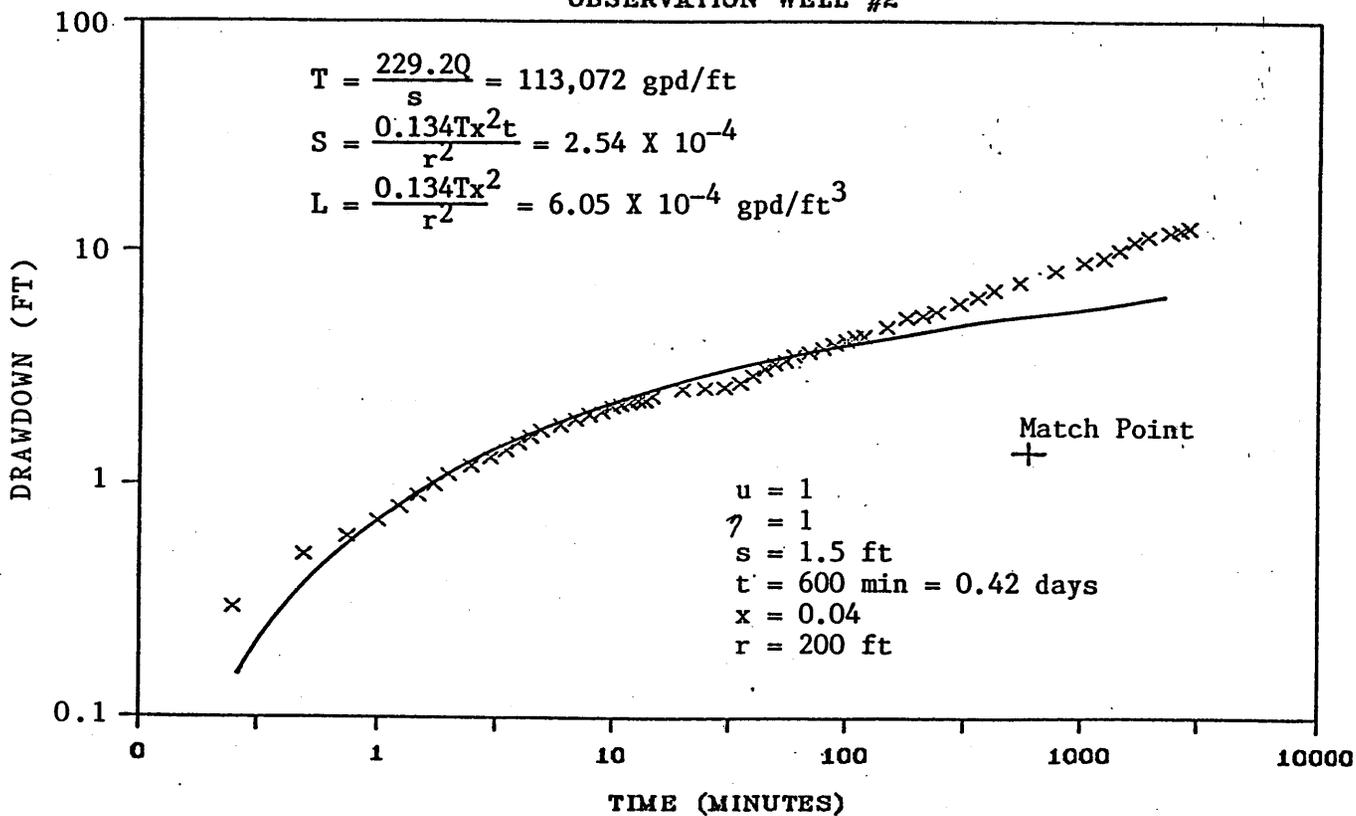
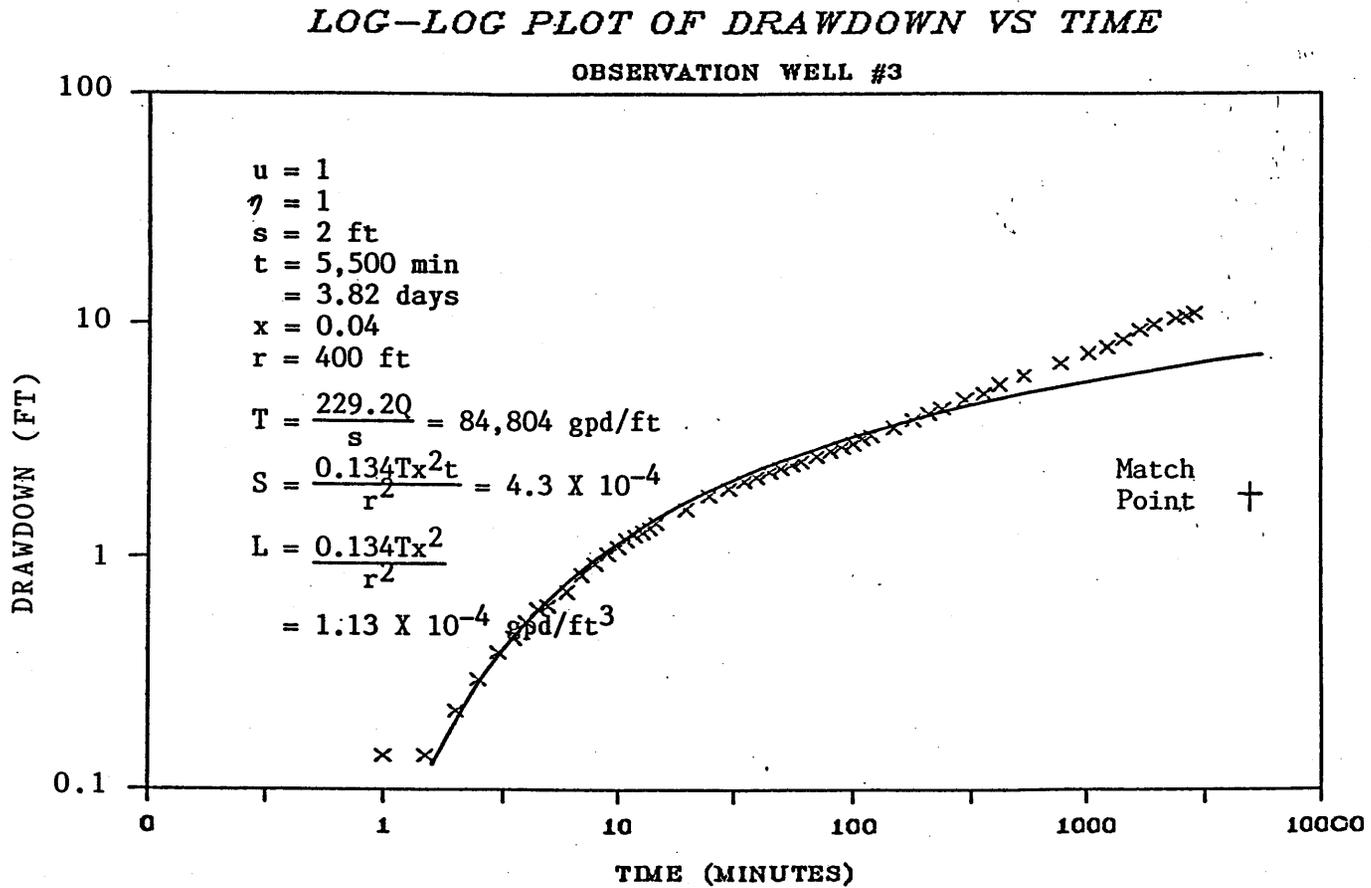


Figure 13: Log-Log Plot of Drawdown vs Time for Observation Well #2
Used for Glover Analysis

Figure 14: Log-Log Plot of Drawdown vs Time for Observation Well #3
 Used for Glover Analysis



SEMI-LOG PLOT OF RECOVERY DATA

OBSERVATION WELL #1

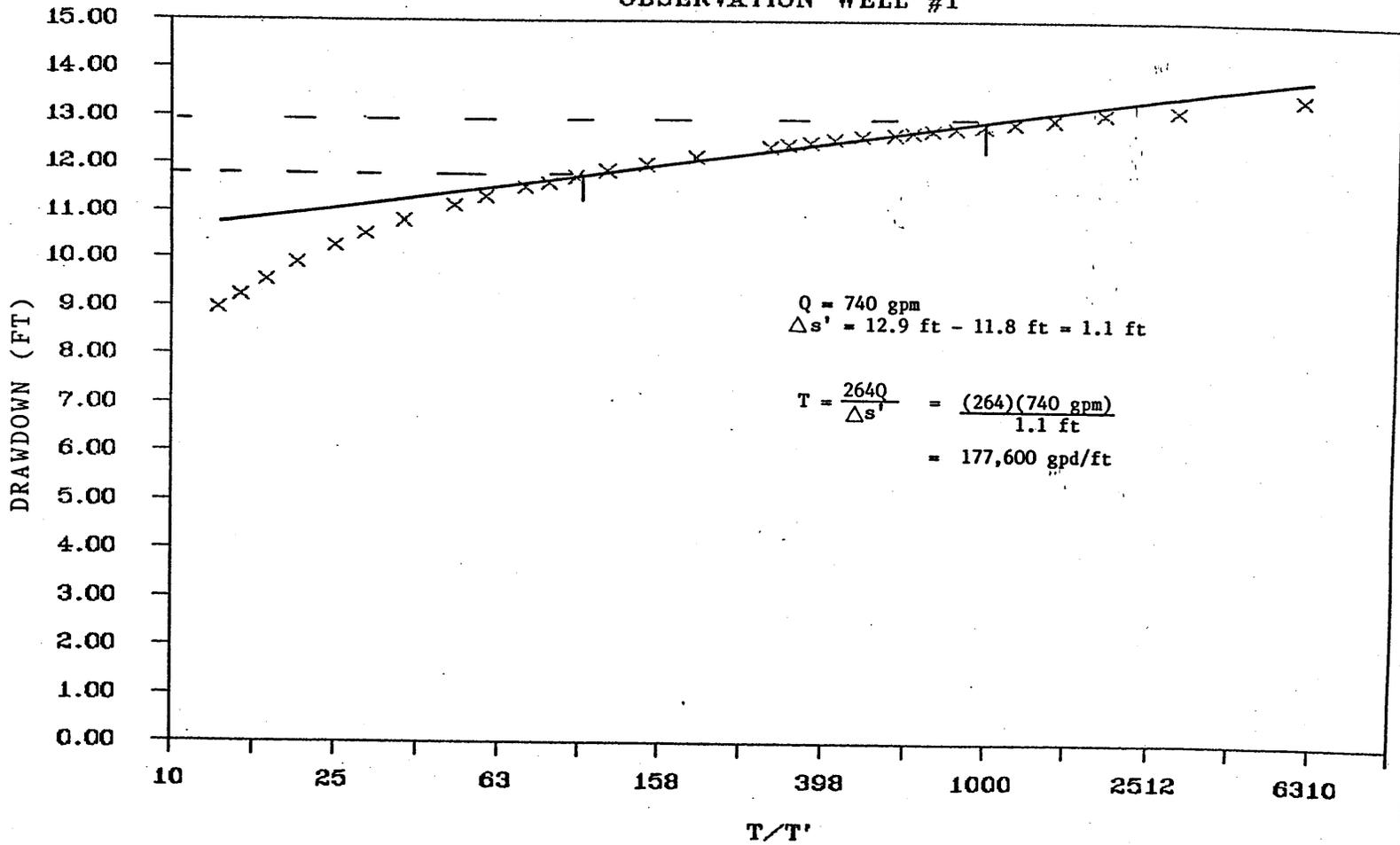


Figure 15: Semi-Log Plot of Recovery Data
Observation Well #1

SEMI-LOG PLOT OF RECOVERY DATA

OBSERVATION WELL #2

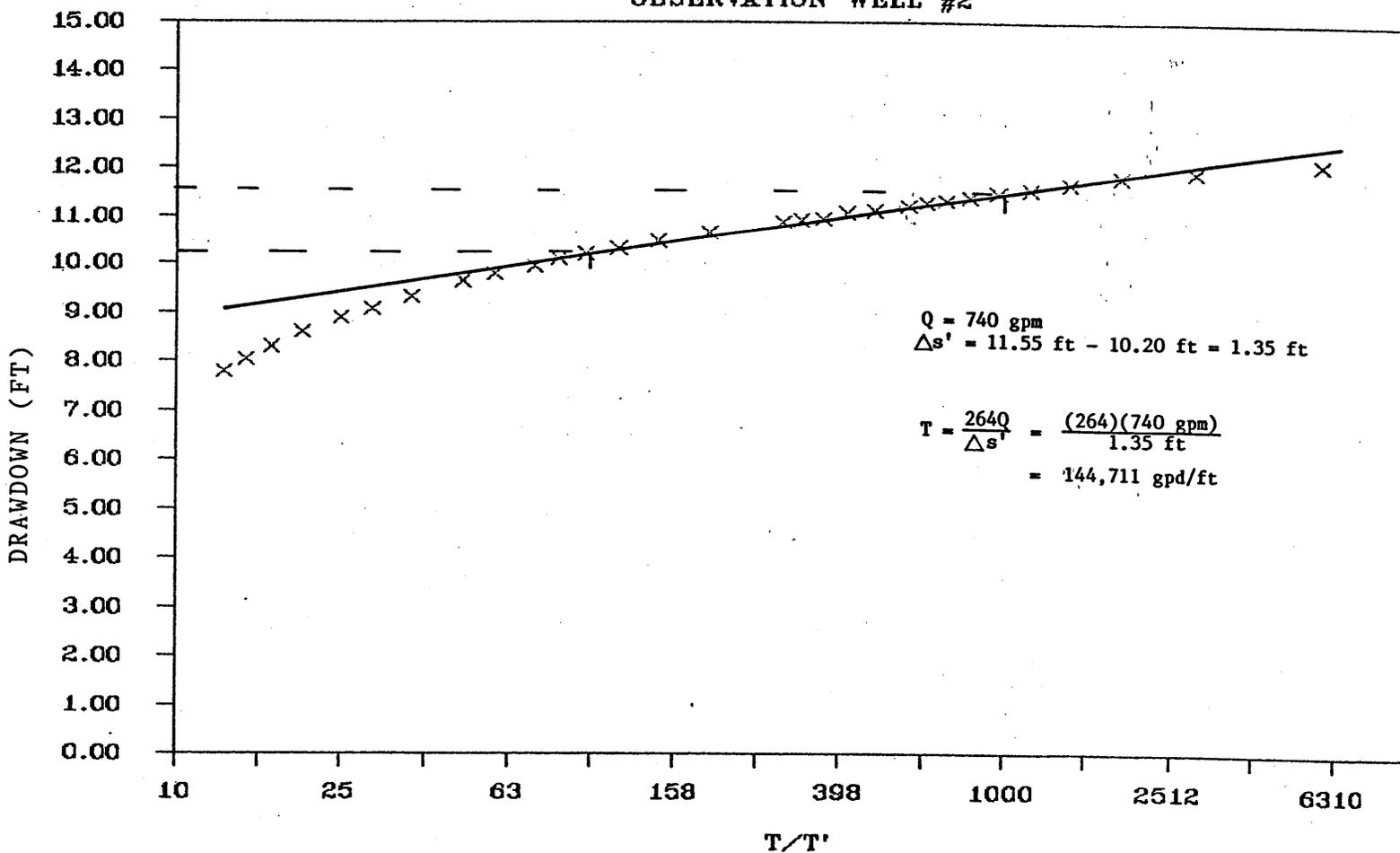


Figure 16: Semi-Log Plot of Recovery Data
Observation Well #2

SEMI-LOG PLOT OF RECOVERY DATA

OBSERVATION WELL #3

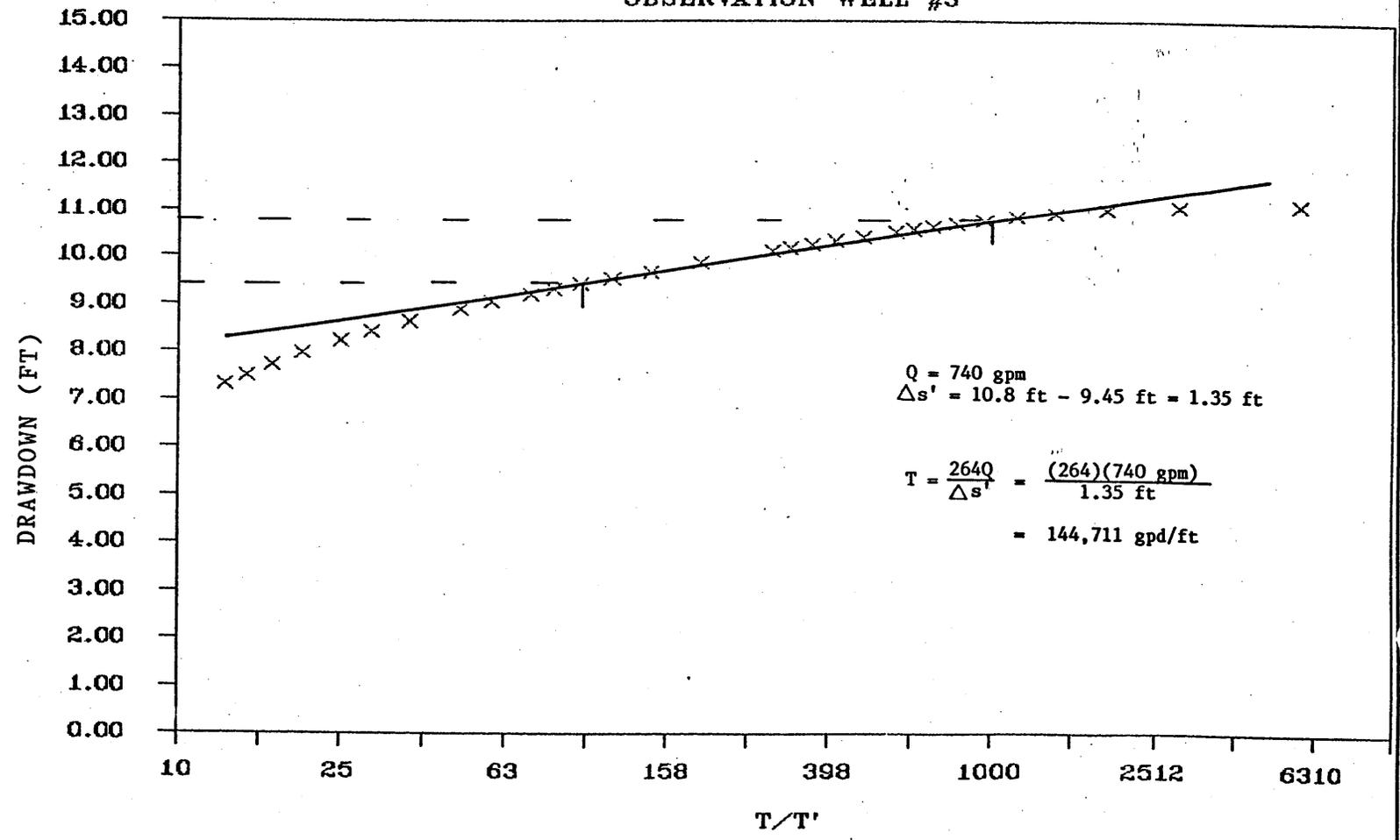


Figure 17: Semi-Log Plot of Recovery Data
Observation Well #3

Table 2

Summary of Aquifer Characteristics

| | | |
|------------------------------------|--|---|
| Theis | T = 121,148 gpd/ft S = 0.00029 | T = 88,338 gpd/ft S = 0.00045 |
| Glover | T = 113,072 gpd/ft S = 0.000254 L = 0.0006 gpd/ft ³ | T = 84,804 gpd/ft S = 0.00043 L = 0.00013 gpd/ft ³ |
| Jacob- Hantush Time-Drawdown | T = 186,057 gpd/ft S = 0.00022 | T = 134,731 gpd/ft S = 0.00034 |
| Jacob- Hantush Recovery | T = 177,600 gpd/ft | T = 144,711 gpd/ft T = 144,711 gpd/ft |
| Distance- Drawdown | T = 132,447 gpd/ft S = 0.00014 | L = 0.0011 gpd/ft ³ |

Average values:

T = 131,137 gpd/ft S = 0.0003 L = 0.0006 gpd/ft³

AQUIFER PERFORMANCE TEST FORM

NAME: Walter Ferguson
PROJECT NAME:

DATE OF TEST: 3/15/87
LOCATION: S 27 T 42 R 2

DISTANCE FROM PUMPED WELL: 50 FEET WEATHER CONDITIONS: clear
PUMPING RATE: 740 GPM
WELL #: 1 STATIC W L (FT BELOW TOC) 2.26

| TIME (IN MINUTES) | WATER LEVEL FROM TOC | DRAWDOWN IN FEET |
|----------------------|-------------------------|---------------------|
| 0.25 | 4.80 | 2.54 |
| 0.50 | 4.87 | 2.61 |
| 0.75 | 4.88 | 2.62 |
| 1.00 | 5.05 | 2.79 |
| 1.25 | 5.07 | 2.81 |
| 1.50 | 5.09 | 2.83 |
| 1.75 | 5.15 | 2.89 |
| 2.00 | 5.25 | 2.99 |
| 2.50 | 5.40 | 3.14 |
| 3.00 | 5.48 | 3.22 |
| 3.50 | 5.50 | 3.24 |
| 4.00 | 5.55 | 3.29 |
| 4.50 | 5.60 | 3.34 |
| 5.00 | 5.68 | 3.42 |
| 6.00 | 5.75 | 3.49 |
| 7.00 | 5.83 | 3.57 |
| 8.00 | 5.90 | 3.64 |
| 9.00 | 5.96 | 3.70 |
| 10.00 | 6.00 | 3.74 |
| 11.00 | 6.05 | 3.79 |
| 12.00 | 6.10 | 3.84 |
| 13.00 | 6.14 | 3.88 |
| 14.00 | 6.18 | 3.92 |
| 15.00 | 6.23 | 3.97 |

PROJECT: Ferguson
TIME
(IN MINUTES)

DATE: 3/15/87
WATER LEVEL
FROM TOC

WELL#: 1
DRAWDOWN
IN FEET

| | | |
|--------|-------|------|
| 20.00 | 6.41 | 4.15 |
| 25.00 | 6.55 | 4.29 |
| 30.00 | 6.70 | 4.44 |
| 35.00 | 6.85 | 4.59 |
| 40.00 | 6.98 | 4.72 |
| 45.00 | 7.10 | 4.84 |
| 50.00 | 7.20 | 4.94 |
| 55.00 | 7.25 | 4.99 |
| 60.00 | 7.35 | 5.09 |
| 70.00 | 7.62 | 5.36 |
| 80.00 | 7.72 | 5.46 |
| 90.00 | 7.90 | 5.64 |
| 115.00 | 8.20 | 5.94 |
| 120.00 | 8.30 | 6.04 |
| 150.00 | 8.67 | 6.41 |
| 180.00 | 8.97 | 6.71 |
| 210.00 | 9.38 | 7.12 |
| 240.00 | 9.63 | 7.37 |
| 300.00 | 10.15 | 7.89 |
| 360.00 | 10.60 | 8.34 |
| 420.00 | 11.10 | 8.84 |
| 540.00 | 11.78 | 9.52 |

PROJECT: Ferguson

DATE: 3/15/87

WELL#: 1

TIME
(IN MINUTES)

WATER LEVEL
FROM TOC

DRAWDOWN
IN FEET

| | | |
|---------|-------|-------|
| 780.00 | 12.75 | 10.49 |
| 1020.00 | 13.52 | 11.26 |
| 1230.00 | 14.22 | 11.96 |
| 1440.00 | 15.10 | 12.84 |
| 1680.00 | 16.15 | 13.89 |
| 1920.00 | 16.75 | 14.49 |
| 2400.00 | 17.30 | 15.04 |
| 2640.00 | 17.55 | 15.29 |
| 2880.00 | 18.95 | 16.69 |

AQUIFER PERFORMANCE TEST FORM

NAME: Walter Ferguson
 PROJECT NAME:

DATE OF TEST: 3/15/87
 LOCATION: S 27 T 42 R 2

DISTANCE FROM PUMPED WELL: 150 FEET WEATHER CONDITIONS: clea
 PUMPING RATE: 740 GPM

WELL #: 2 STATIC W L (FT BELOW TOC) 2.10

| TIME (IN MINUTES) | WATER LEVEL FROM TOC | DRAWDOWN IN FEET |
|----------------------|-------------------------|---------------------|
| 0.25 | 2.40 | 0.30 |
| 0.50 | 2.60 | 0.50 |
| 0.75 | 2.70 | 0.60 |
| 1.00 | 2.80 | 0.70 |
| 1.25 | 2.90 | 0.80 |
| 1.50 | 3.00 | 0.90 |
| 1.75 | 3.10 | 1.00 |
| 2.00 | 3.20 | 1.10 |
| 2.50 | 3.30 | 1.20 |
| 3.00 | 3.40 | 1.30 |
| 3.50 | 3.50 | 1.40 |
| 4.00 | 3.60 | 1.50 |
| 4.50 | 3.70 | 1.60 |
| 5.00 | 3.80 | 1.70 |
| 6.00 | 3.90 | 1.80 |
| 7.00 | 4.00 | 1.90 |
| 8.00 | 4.10 | 2.00 |
| 9.00 | 4.15 | 2.05 |
| 10.00 | 4.25 | 2.15 |
| 11.00 | 4.30 | 2.20 |
| 12.00 | 4.35 | 2.25 |
| 13.00 | 4.40 | 2.30 |
| 14.00 | 4.40 | 2.30 |
| 15.00 | 4.50 | 2.40 |

PROJECT: Ferguson
TIME
(IN MINUTES)

DATE: 3/15/87
WATER LEVEL
FROM TOC

WELL#: 2
DRAWDOWN
IN FEET

| | | |
|--------|------|------|
| 20.00 | 4.68 | 2.58 |
| 25.00 | 4.70 | 2.60 |
| 30.00 | 4.72 | 2.62 |
| 35.00 | 4.85 | 2.75 |
| 40.00 | 5.05 | 2.95 |
| 45.00 | 5.25 | 3.15 |
| 50.00 | 5.40 | 3.30 |
| 55.00 | 5.50 | 3.40 |
| 60.00 | 5.70 | 3.60 |
| 70.00 | 5.80 | 3.70 |
| 80.00 | 5.95 | 3.85 |
| 90.00 | 6.10 | 4.00 |
| 100.00 | 6.26 | 4.16 |
| 110.00 | 6.40 | 4.30 |
| 120.00 | 6.45 | 4.35 |
| 150.00 | 6.85 | 4.75 |
| 180.00 | 7.30 | 5.20 |
| 210.00 | 7.41 | 5.31 |
| 240.00 | 7.65 | 5.55 |
| 300.00 | 8.12 | 6.02 |
| 360.00 | 8.48 | 6.38 |
| 420.00 | 8.94 | 6.84 |
| 540.00 | 9.53 | 7.43 |

PROJECT: Ferguson
TIME
(IN MINUTES)

DATE: 3/15/87
WATER LEVEL
FROM TOC

WELL#: 2
DRAWDOWN
IN FEET

| | | |
|---------|-------|-------|
| 780.00 | 10.40 | 8.30 |
| 1020.00 | 11.10 | 9.00 |
| 1230.00 | 11.56 | 9.46 |
| 1440.00 | 12.28 | 10.18 |
| 1680.00 | 13.20 | 11.10 |
| 1920.00 | 13.75 | 11.65 |
| 2400.00 | 14.25 | 12.15 |
| 2640.00 | 14.52 | 12.42 |
| 2880.00 | 14.85 | 12.75 |

AQUIFER PERFORMANCE TEST FORM

NAME: Walter Ferguson
PROJECT NAME:

DATE OF TEST: 3/15/87
LOCATION: S 27 T 42 R 2

DISTANCE FROM PUMPED WELL: 400 FEET WEATHER CONDITIONS: clea
PUMPING RATE: 740 GPM

WELL #: 3 STATIC W L (FT BELOW TOC) 2.42

| TIME (IN MINUTES) | WATER LEVEL FROM TOC | DRAWDOWN IN FEET |
|----------------------|-------------------------|---------------------|
| 0.50 | 2.42 | 0.00 |
| 1.00 | 2.56 | 0.14 |
| 1.50 | 2.56 | 0.14 |
| 2.00 | 2.64 | 0.22 |
| 2.50 | 2.72 | 0.30 |
| 3.00 | 2.81 | 0.39 |
| 3.50 | 2.87 | 0.45 |
| 4.00 | 2.95 | 0.53 |
| 4.50 | 3.02 | 0.60 |
| 5.00 | 3.04 | 0.62 |
| 6.00 | 3.13 | 0.71 |
| 7.00 | 3.26 | 0.84 |
| 8.00 | 3.35 | 0.93 |
| 9.00 | 3.45 | 1.03 |
| 10.00 | 3.52 | 1.10 |
| 11.00 | 3.60 | 1.18 |
| 12.00 | 3.65 | 1.23 |
| 13.00 | 3.70 | 1.28 |
| 14.00 | 3.75 | 1.33 |
| 15.00 | 3.82 | 1.40 |

PROJECT: Ferguson
TIME
(IN MINUTES)

DATE: 3/15/87
WATER LEVEL
FROM TOC

WELL#: 3
DRAWDOWN
IN FEET

| | | |
|--------|------|------|
| 20.00 | 4.03 | 1.61 |
| 25.00 | 4.25 | 1.83 |
| 30.00 | 4.39 | 1.97 |
| 35.00 | 4.53 | 2.11 |
| 40.00 | 4.63 | 2.21 |
| 45.00 | 4.74 | 2.32 |
| 50.00 | 4.83 | 2.41 |
| 55.00 | 4.92 | 2.50 |
| 60.00 | 4.99 | 2.57 |
| 70.00 | 5.14 | 2.72 |
| 80.00 | 5.28 | 2.86 |
| 90.00 | 5.39 | 2.97 |
| 100.00 | 5.51 | 3.09 |
| 110.00 | 5.66 | 3.24 |
| 120.00 | 5.75 | 3.33 |
| 150.00 | 6.03 | 3.61 |
| 180.00 | 6.30 | 3.88 |
| 210.00 | 6.55 | 4.13 |
| 240.00 | 6.80 | 4.38 |
| 300.00 | 7.19 | 4.77 |
| 360.00 | 7.47 | 5.05 |
| 420.00 | 7.92 | 5.50 |
| 540.00 | 8.45 | 6.03 |

PROJECT: Ferguson
TIME
(IN MINUTES)

DATE: 3/15/87
WATER LEVEL
FROM TOC

WELL#: 3
DRAWDOWN
IN FEET

| | | |
|---------|-------|-------|
| 780.00 | 9.25 | 6.83 |
| 1020.00 | 9.92 | 7.50 |
| 1230.00 | 10.40 | 7.98 |
| 1440.00 | 11.11 | 8.69 |
| 1680.00 | 11.89 | 9.47 |
| 1920.00 | 12.40 | 9.98 |
| 2400.00 | 13.02 | 10.60 |
| 2640.00 | 13.27 | 10.85 |
| 2880.00 | 13.57 | 11.15 |