OPTIMIZATION BY LEVENBERG-MARQUARDT MINIMIZATION ALGORITHM

ITER	FUNCTION	TRANSMISS	STORTIVTY	SPEC_LEAK
1	.566E-01	.6163E+05	.2100E-03	.1700E-01
3	.403E-01	.6454E+05	.1992E-03	.1097E-01
4	.121E-01	.6952E+05	.1850E-03	.3723E-02
6	.565E-02	.6348E+05	.1902E-03	.3032E-02
8	.513E-02	.5986E+05	.2429E-03	.4746E-02
9	.513E-02	.6103E+05	.2262E-03	.4367E-02
11	.512E-02	.6114E+05	.2231E-03	.4270E-02
12	.512E-02	.6118E+05	.2226E-03	.4255E-02

TERMINATION DUE TO PARAMETER CONVERGENCE

FINAL RESULTS

ITER	FUNCTION	TRANSMISS	STORTIVTY	SPEC_LEAK
12	.512E-02	.6118E+05	.2225E-03	.4255E-02

FRACTIONAL COMPONENTS OF FUNCTION VALUE

WELL # 1

1.000

DO YOU WANT A SENSITIVITY ANALYSIS ? (Y/N)

SENSITIVITY ANALYSIS

TWO STANDARD DEVIATION CONFIDENCE INTERVALS

PARAMETER	VALUE	LOWER LIMIT	UPPER LIMIT
TRANSMISS	.6118E+05	0.6107E+05	0.6129E+05
STORTIVTY	.2225E-03	0.0000	0.3745E-02
SPEC_LEAK	.4252E-02	0.0000	0.4326E-01

TO CONTINUE ENTER "RETURN"

McDaniels

T = 457,626 gpd/ft

K = 1055 ft/d

S = 2.225 E-4

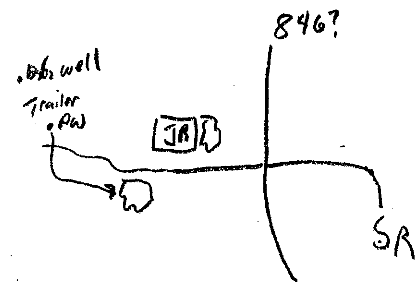
$K'/b' = 4.255 \times 10^{-3}$ day^{-1}

1 obs well

1 pumped well

r = 206' 10"

[illegible]

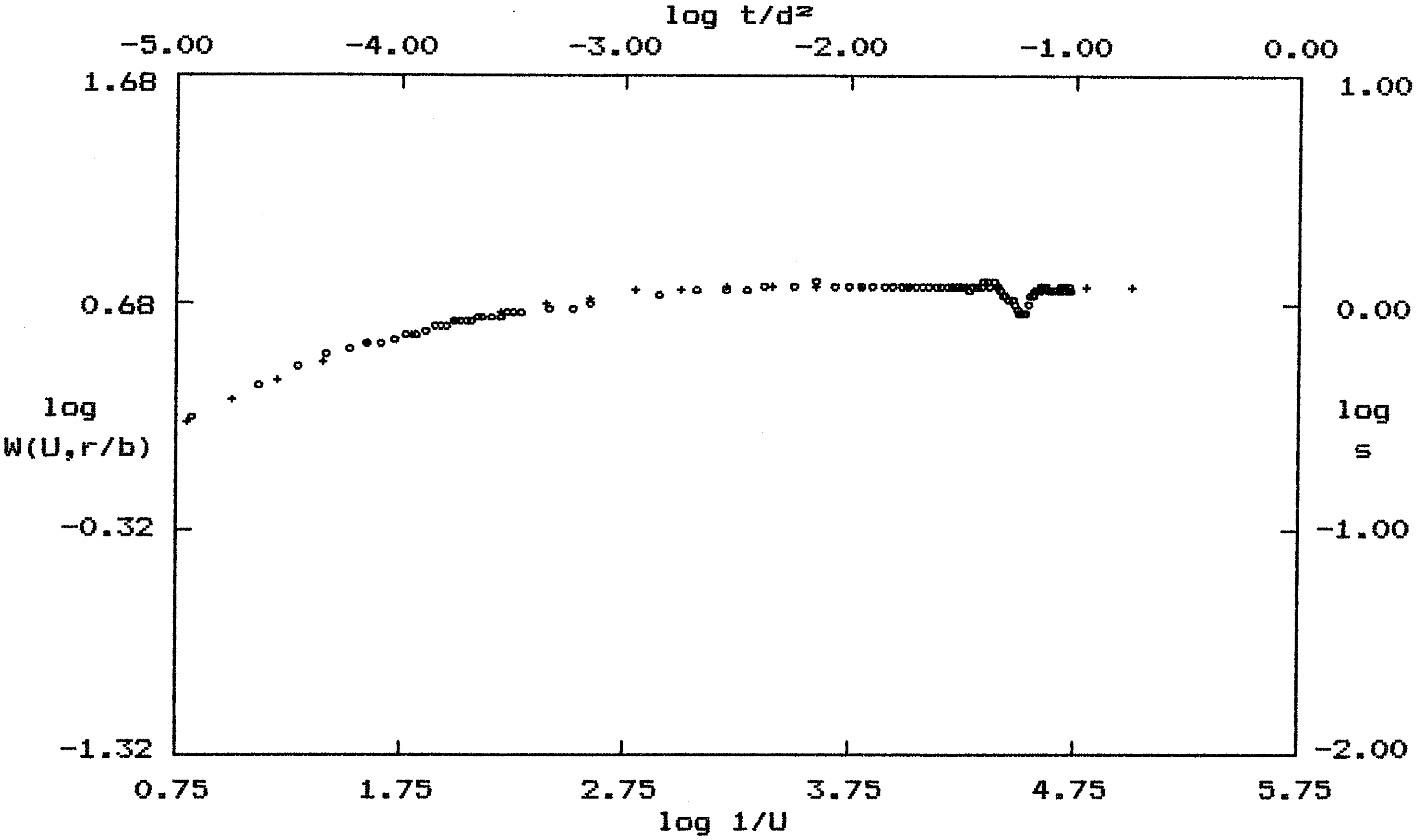


T = 461,000

$S = 2.1 \times 10^{-4}$

L = .017

PUMP TEST DATA



o - Data

+ - Type Curve
Confined Leaky: r/B = 0.06

SOLUTION

Transmissivity = 3.895E+01 ft.²/min. = 419,538 gpd/ft
Storativity = 2.771E-04

McDaniels

HYDRO DESIGNS
Consultants in Hydrogeology & Hydrology
1591 Hollyhock Road
Wellington, Florida 33414
(305) 798-4585

this data was not submitted until after the staff report was prepared.

Walter Ward
South Florida Water Management District
P.O. Box V, 3301 Gun Club Road
West Palm Beach, Florida 33404

May 5, 1986

Dear Walter,

Enclosed you will find the results of a pump test that we ran on Bobby McDaniels' property in Hendry County. Hopefully this will satisfy the limiting condition of an aquifer performance test for his water use permit.

I feel the aquifer parameter values are representative for the lower Tamiami aquifer in this area. The values will probably vary dramatically to the east and north because of lithofacies within the geologic formations. Our major concern during the test was a pond located about 120 feet from the observation well. The water level in the pond showed a steady decline starting at 6 hours from the onset of the test. The water levels of the lower Tamiami are surely affected by the leakance of water from the overlying water table aquifer accross the Tamiami confining beds. The pond water level would closely estimate the water table elevation as it was only about 8 feet deep. The pond represents 100% storage and may have caused our leakance values to be lower than expected.

If you have any questions on this data or need additional information, please contact me a 305-586-7127. Our new office address is HydroDesigns, Inc., 2875 South Ocean Blvd, Suite 200, Palm Beach, Florida, 33480.

Sincerely,

Michael S. Knapp, CPGS
President

* where was the test performed?
test layout?
well depths?
construction details?

TABLE 1 - Aquifer Test Data

Time (min)	Pumped Well TD = 118' CS = 60'	Obs. Well TD = 62' CS = 52' r = 206'10"	Pond	Manometer 6" pipe 5" orofice
4-17-86 5:39 pm	s (ft)	s (ft)	s (ft)	gpm
0.0	0.00	0.00	0.00	765
0.5	3.90	.32		759
1.0	3.92	.43		
1.5	3.94	.53		
2.0	3.97	.59		
2.5	3.99	.62		
3.0	4.00	.65		
3.5	4.03	.67		
4.0	4.05	.69		
4.5	4.07	.71		
5.0	4.09	.74		
5.5	4.12	.76		
6.0	4.17	.79		
6.5	4.17	.81		
7.0	4.18	.81		
7.5	4.20	.82		
8.0	4.21	.82		
8.5	4.22	.83		
9.0	4.23	.85		
9.5	4.25	.86		
10.0	4.24	.86	0.00	754
11.0	4.28	.87		
12.0	4.30	.89		
13.0	4.32	.90		
14.0	4.32	.91		759
15.0	4.33	.92		759
20.0	4.25	.94	0.00	751
25.0	4.30	.96		754
30.0	4.55	1.01		759
60.0	4.53	1.11		759
90.0	4.80	1.17		757
120	4.65	1.16		765
150	4.66	1.16		765
180	4.73	1.19		759
240	4.72	1.21		765
300	4.74	1.24	0.02	770
360	4.70	1.23		765
420	4.64	1.22		765
480	4.70	1.21		759
540	4.70	1.21		765
600	4.71	1.20	0.03	770
660	4.72	1.21		768
720	4.70	1.21		770

Time	s	s	s	gpm
780	4.73	1.20	.03	770
840	4.70	1.19	.04	759
900	4.60	1.21		765
960	4.64	1.20		765
1020	4.65	1.20		759
1080	4.60	1.18		759
1140	4.55	1.20	.05	754
1200	4.60	1.20		754
1260	4.55	1.19	.06	748
1320	4.63	1.22		762
1380	4.60	1.21		754
1440	4.60	1.17	.07	759
1500	4.70	1.22		770
1560	4.70	1.22		765
1620	4.61	1.23		765
1680	4.75	1.25		770
1740	4.72	1.24		765
1800	4.71	1.23	.09	765
1860	4.72	1.24		770
1920	4.71	1.20		759
1980	4.69	1.17		759
2040	4.65	1.12		765
2100	4.66	1.09		754
2160	4.64	1.06		748
2220	4.61	1.03	.11	765
2280	4.53	1.00		765
2340	4.43	.96		759
2400	4.32	.91		748
2460	4.28	.90		743
2520	4.29	.90		765
2580	4.44	.91		773
2640	4.49	1.00		765
2700	4.59	1.11		773
2760	4.60	1.09		770
2820	4.65	1.16		765
2880	4.65	1.17	.13	770
2940	4.68	1.17		776
3000	4.80	1.21		790
3060	4.63	1.21		759
3120	4.70	1.20		754
3180	4.65	1.18		765
3240	4.70	1.17		765
3300	4.65	1.17	.15	765
3360	4.69	1.17		770
3420	4.65	1.16		759
3480	4.64	1.17		765
3540	4.63	1.15		754
3600	4.65	1.16	.16	754
3660	4.63	1.16		748
3720	4.68	1.19		765

TIME	s	s	s	gpm
3720	4.68	1.19	.16	765
3780	4.66	1.20	.18	765
3840	4.50	1.16		743
3900	4.54	1.17		748
3960	4.61	1.18	.19	759
4020	4.63	1.16	.20	754
4080	4.61	1.15	.20	754

RECOVERY DATA

Time	Pumped Well s'	Obs. Well s' = residual drawdown
0.0		
0.5	.95	.94
1.0	.90	.79
1.5	.75	.70
2.0	.70	.63
2.5	.65	.57
3.0	.65	.55
3.5	.60	.53
4.0	.55	.50
4.5	.55	.48
5.0	.55	.46
6.0	.52	.42
7.0	.50	.40
8.0	.48	.38
9.0	.45	.35
10	.43	.33
11	.42	.31
12	.40	.30
13	.39	.28
14	.38	.27
15	.37	.26
20	.32	.22
25	.29	.18
30	.26	.15
40	.23	.13
50	.20	.10
60	.18	.07
90	.15	.04
120	.14	.03
150	.13	.02
180	.13	.00

Time / drawdown data collected during the April 18th pump test were analysed using non-equilibrium equations for unsteady radial flow to determine transmissivity, storage and leakage values. Drawdown data collected at the observation well during pumping were evaluated using 1) the Hantush and 2) the Jacob methods. Review of these data indicate the pumped zone (60 to 100 feet below land surface) acts as a semi-confined leaky aquifer. While no cuttings were available from the test wells this assumption is further supported by lithologic data collected from a well located x miles away (description attached). This data indicated that the pumped zone is the lower Tamiami aquifer as described by Knapp, Burns, and Sharp in SFWMD Technical Publication 86-1.

Using the curve matching procedure proposed by Hantush and later modified by Cooper the time versus drawdown data are evaluated as shown on figure 1. Under ideal conditions the time drawdown curve for a fully confined or unconfined aquifer should match the Theis curve shown on figure 1. Actual field data from the pump test shows significant departure from the Theis curve after 5 minutes of pumpage. This is caused by leakage accross the semi-confining beds which separates the water table from the lower Tamiami aquifer. Using the match point values determined from the curve matching procedure the following aquifer coefficients were calculated:

Transmissivity (T) = 461,000 gpd/ft
Storage Coef. (S) = 2.1 X 10E4
Leakage (K/b) = 0.017 gpd/cubic ft.

The small storage value calculated is indicative of confined aquifers and compares well with early time values calculated for this aquifer in Collier County (SFWMD 86-1). Calculated impacts of pumpage using this value of storage will yield larger drawdowns than would actually occur for the aquifer. Leakance from the water table aquifer accross the Tamiami confining beds provides the major source of water to the pumped wells and acts to minimize drawdowns in theie vicinity. Aquifer modelling to determine impacts of pumpage must include leakance effects.

Because only one observation well was used in the pump test the drawdown and recovery (collected after pumpage was terminated) data was evaluated using the Jacob method (figure 2 and 3). These analysis verified the aquifer parameter values determined from the Hantush curve matching technique. Table 1 is the data derived from the aquifer performance test.

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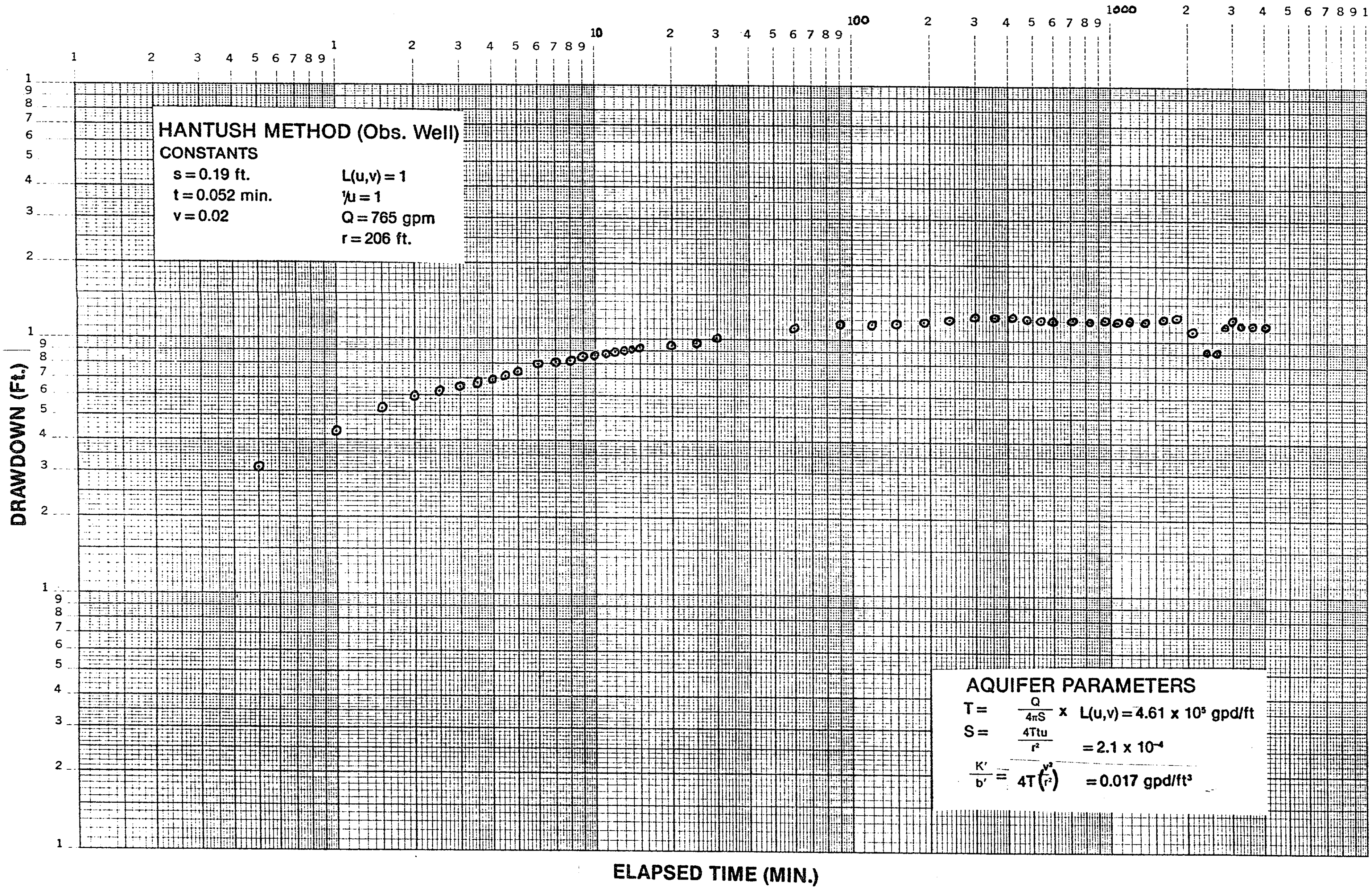

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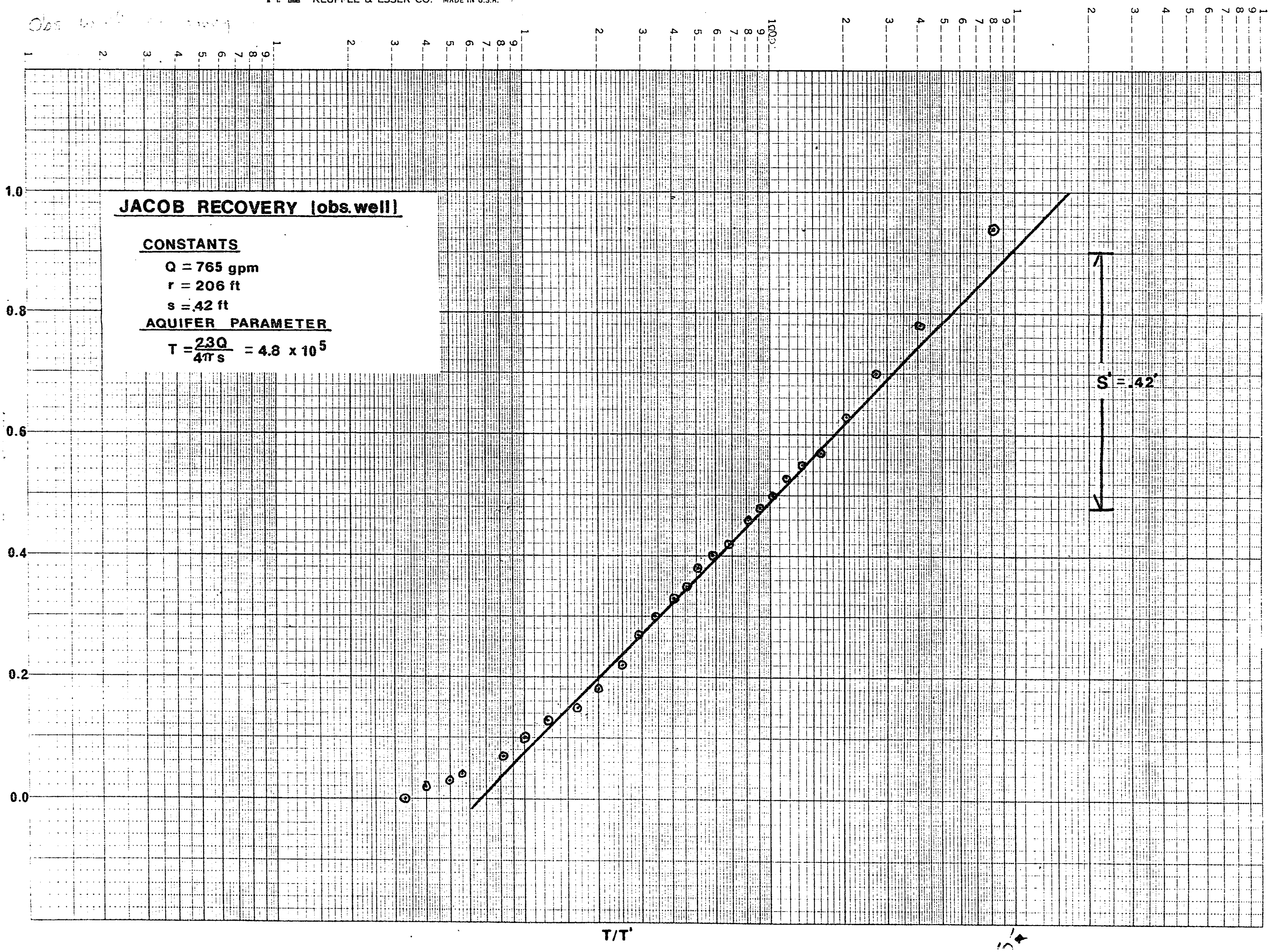

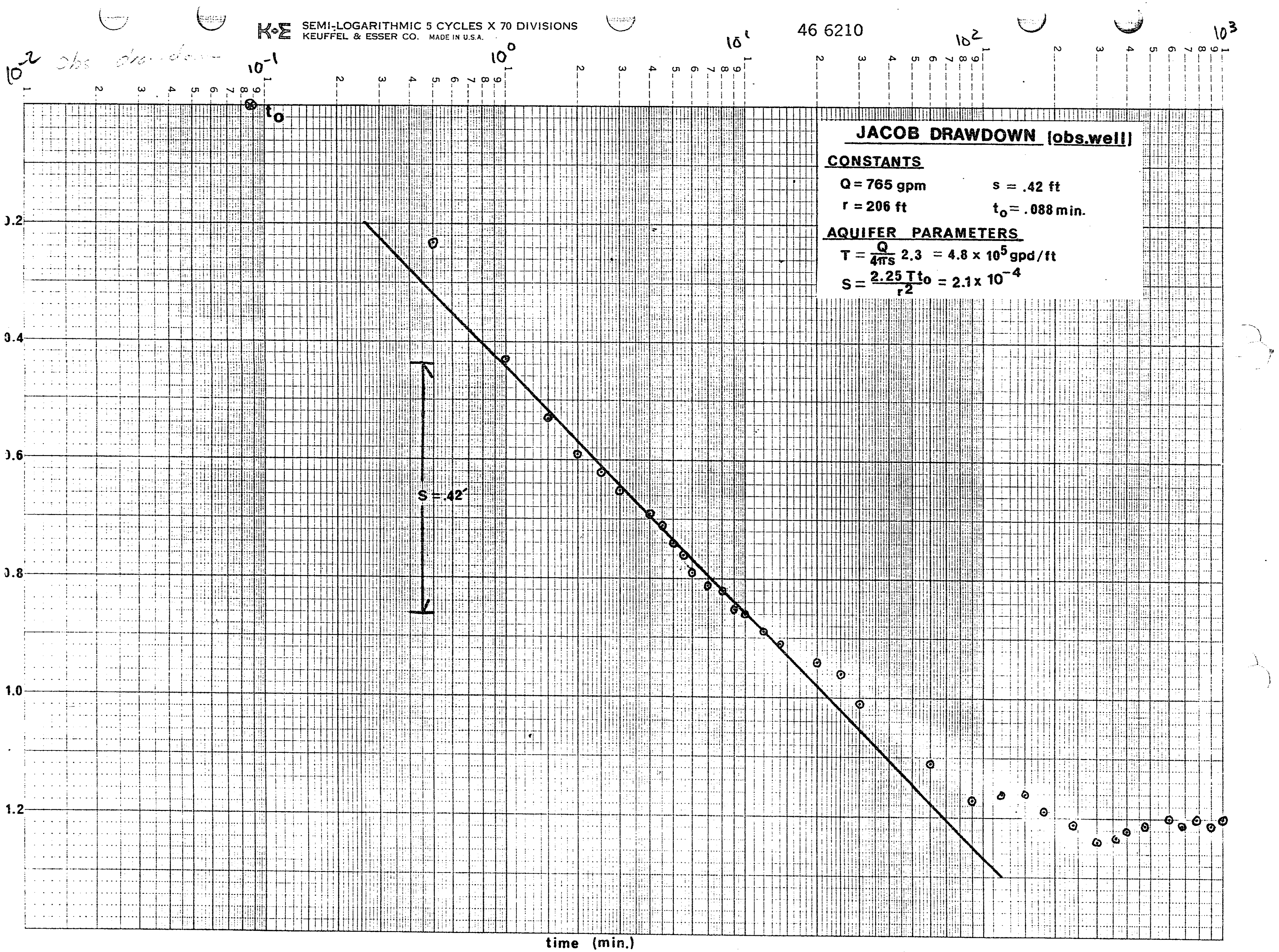

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46 6210
JACOB DRAWDOWN (obs.well)
CONSTANTS
Q = 765 gpm
s = .42 ft
r = 206 ft
t₀ = .088 min.
AQUIFER PARAMETERS
T = Q/4πs 2.3 = 4.8 x 10^5 gpd/ft
S = 2.25 Tt₀/r² = 2.1 x 10^-4
S = .42'
t₀
0.2
0.4
0.6
0.8
1.0
1.2
time (min.)

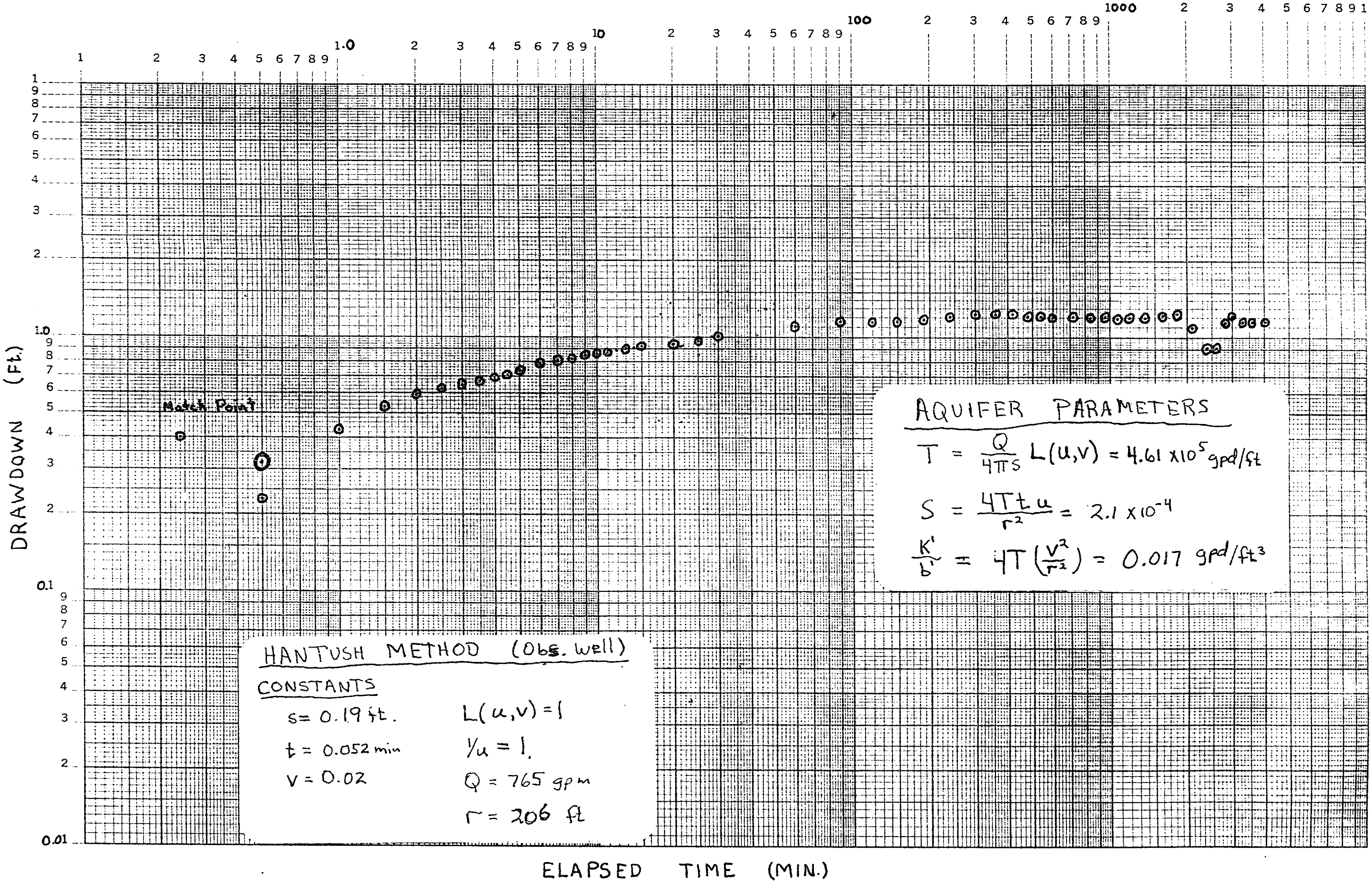
DRAWDOWN (Ft.)
ELAPSED TIME (MIN.)
Match Point
AQUIFER PARAMETERS
T = Q/4πs L(u,v) = 4.61 x10^5 gpd/ft
S = 4Ttu/r² = 2.1 x10^-4
K'/b' = 4T (v²/r²) = 0.017 gpd/ft³
HANTUSH METHOD (Obs. well)
CONSTANTS
s = 0.19 ft.
t = 0.052 min
v = 0.02
L(u,v) = 1
1/u = 1
Q = 765 gpm
r = 206 ft

TABLE 1 - Aquifer Test Data

Time (min)	Pumped Well TD = 118' CS = 60'	Obs. Well TD = 62' CS = 52' r = 206'10"	Pond	Manometer 6" pipe 5" orofice
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7.0	4.18	.81		
7.5	4.20	.82		
8.0	4.21	.82		
8.5	4.22	.83		
9.0	4.23	.85		
9.5	4.25	.86		
10.0	4.24	.86	0.00	754
11.0	4.28	.87		
12.0	4.30	.89		
13.0	4.32	.90		
14.0	4.32	.91		759
15.0	4.33	.92		759
20.0	4.25	.94	0.00	751
25.0	4.30	.96		754
30.0	4.55	1.01		759
60.0	4.53	1.11		759
90.0	4.80	1.17		757
120	4.65	1.16		765
150	4.66	1.16		765
180	4.73	1.19		759
240	4.72	1.21		765
300	4.74	1.24	0.02	770
360	4.70	1.23		765
420	4.64	1.22		765
480	4.70	1.21		759
540	4.70	1.21		765
600	4.71	1.20	0.03	770
660	4.72	1.21		768
720	4.70	1.21		770

Time	s	s	s	gpm
780	4.73	1.20	.03	770
840	4.70	1.19	.04	759
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960	4.64	1.20		765
1020	4.65	1.20		759
1080	4.60	1.18		759
1140	4.55	1.20	.05	754
1200	4.60	1.20		754
1260	4.55	1.19	.06	748
1320	4.63	1.22		762
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1440	4.60	1.17	.07	759
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2520	4.29	.90		765
2580	4.44	.91		773
2640	4.49	1.00		765
2700	4.59	1.11		773
2760	4.60	1.09		770
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2880	4.65	1.17	.13	770
2940	4.68	1.17		776
3000	4.80	1.21		790
3060	4.63	1.21		759
3120	4.70	1.20		754
3180	4.65	1.18		765
3240	4.70	1.17		765
3300	4.65	1.17	.15	765
3360	4.69	1.17		770
3420	4.65	1.16		759
3480	4.64	1.17		765
3540	4.63	1.15		754
3600	4.65	1.16	.16	754
3660	4.63	1.16		748
3720	4.68	1.19		765

TIME	s	s	s	gpm
3720	4.68	1.19	.16	765
3780	4.66	1.20	.18	765
3840	4.50	1.16		743
3900	4.54	1.17		748
3960	4.61	1.18	.19	759
4020	4.63	1.16	.20	754
4080	4.61	1.15	.20	754

RECOVERY DATA

Time	Pumped Well s'	Obs. Well s'
0.0		
0.5	.95	.94
1.0	.90	.79
1.5	.75	.70
2.0	.70	.63
2.5	.65	.57
3.0	.65	.55
3.5	.60	.53
4.0	.55	.50
4.5	.55	.48
5.0	.55	.46
6.0	.52	.42
7.0	.50	.40
8.0	.48	.38
9.0	.45	.35
10	.43	.33
11	.42	.31
12	.40	.30
13	.39	.28
14	.38	.27
15	.37	.26
20	.32	.22
25	.29	.18
30	.26	.15
40	.23	.13
50	.20	.10
60	.18	.07
90	.15	.04
120	.14	.03
150	.13	.02
180	.13	.00

s' = residual drawdown

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