Wayne Bearden

Layne
SINCE 1882

South Lucie Well N

114-1215-70

GENERAL DEVELOPMENT UTILITIES, INC.
REPORT OF ANALYSES OF PUMPING TEST AND DETERMINATION OF EFFECTS OF PUMPING.

(PW-4)?

FOR:

LAYNE ATLANTIC COMPANY
P.O. DRAWER 5789
ORLANDO, FLA. 32805

LAYNE NORTHERN CO., INC.
401 S. DELORENZI • P.O. BOX 299 • MISHAWAKA, IND. 46544
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UTILITIES FEB 12 197

Layne NORTHERN COMPANY, INC. WATER SUPPLY CONTRACTOR

February 2, 1970

Layne Atlantic Company
P.O. Drawer 5789
Orlando, Fla. 32805

Attention: Mr. R. G. Cousins

Subject: General Development Utilities, Inc.
Report of Analyses of Pumping Test
and Determination of Effects of Pumping

Dear Mr. Cousins:

This letter report covers results of analyses of pumping test data for the above subject job. The data provided by the client consisted of the following;

1. Well Log - Pumping Well No. 4
2. Well construction details - Well No. 4
3. Location sketch showing distance of Observation Wells from pumping well.
4. Top of pipe and ground surface elevations at each well.
5. Water level measurements with time in five (5) wells.

Attached to this letter-report are the computational sheets which are not rewritten here for the sake of brevity.

Your question to us was "what are the effects in feet of drawdown when producing 400 gpm from 2 wells, with the second well (#5 - proposed well) being 585' remote from No. 4 well".

We have assumed that Well No. 5 will be located approximately the same as Well No. 5-A, existing, and have assumed that its construction will be identical with that of Well No. 4. In order to compute drawdown, it was necessary to assume pumping for a particular time. For these purposes a pumping time of 100 days was picked as a conservative estimating point and continuous, round-the-clock pumping at 200 gpm from each well was assumed.

On this basis we determined the pumping level in each well to be 71' after 100 days continuous pumping. (Figure 3 shows drawdown computed the vicinity of two pumping wells). The pumping level includes 5'0" static water level, 11.8' interference from other well, 28.7' drawdown due to pumping well and 25.4' drawdown due to well losses.

It is noted that a pumping level of 71' is 11' below the top of screen in Well No. 4. However, if we assume cyclic pumping at 200 gpm for 12 hours per day, 7 days per week, the pumping level in the well after 100 days cyclic pumping is computed as 57.5' as compared with 71' for continuous pumping.

Therefore, we feel that 200 gpm is the correct design capacity for Well No. 4 (and Well No. 5 if identical). In addition, the well may continue to develop and the well losses may be reduced in the future which would, in turn, reduce the pumping level in that well. The well losses in Well No. 5 may be quite different from those in Well No. 4.

We are pleased to have performed this analysis for you. If you have any questions concerning this report or the attached analysis please contact us.

Yours truly,

LAYNE NORTHERN COMPANY, INC.

N. Thomas Sheahan

NTS:m

Encl: 1) Analysis
2) Figures 1,2, & 3

General Development Utilities, Inc. 1/30/70

COMPUTATIONAL

1) Data Available: DTW measurements for PW#4 + four OW's
4-A, r=10'; G, r=77'; 5-A, r=585'; 3, r=1100';

Well log for PW #4

0-10'	soil
10'-15'	clay
15'-40'	sand - shell
40'-48'	clay - shell
48'-60'	clay - shell
60'-105	shell - sand.

Well Const. PW#4
46'0" 16" casing, cemented.
40' of 8" SS shutter screen
set 60'-100' w/ 8" blank
set from top of screen to surface
Graveled with 70 bags.

Question? what is well diameter? 8" or 16".

check annulus - assume 8" X 16" = 0.667' X 1.333'

Vol. Annulus / lineal ft $= \frac{\pi}{4}\left[(1.333^2)-(0.667^2)\right](1) = 1.05$ ft³/ft

70 bags gravel, est. 100#/bag, 100#/ft³ ∴ 1 ft³/bag.

70 ft³ / 105 ft³/ft = 66.5 Lineal ft gravel pack which is 26.5' above top of screen, ∴ assu 8" X 16" well correct.

2) Problem: Find "effects in feet of drawdown when producing 400 gpm from 2 wells with second well (#5 - Proposed well) being 585' remote from #4 well."

A) Assume #5 will be near location of #5-A.

B) Assume "400 gpm from 2 wells" means 200 gpm from each, not 400 gpm from each.

2) C) Assume well construction for #5 identical to #4-

D) Assume no outside interference such as other pumping wells, and that surf. trend is horizontal

E) Assume wells will be pumping 200 gpm continuou 24hrs/day for, say, 100 days with no recha

3) Plot depth to water measurements for four OW's versus time, t, since pumping began, Figure 1, ~~and plot~~ and plot drawdown versus distance from PW for four OW's, Figure 2.

A) check slope of s-t curves; 4-A, 6 and 5- correlate well; #3 also good correlation consideri distance $\Delta s/\ln t = 3.05'$

B) Check slope of s-r curves, excellent correlat with closest three, #3 at 1100' also good considering distance. Slope checks out close to twice $\Delta s/\ln t$ ($\Delta s/\ln r \cong 6.1'$)

4) Compute Aquifer Coefficients

$$T = \frac{264Q}{\Delta s/\ln t} = \frac{(264)(200)}{3.05} = 17{,}300 \text{ gpd/ft}$$

$$W(u) = \frac{sT}{114.6Q} \quad ; \quad S = \frac{uTt}{2693\,r^2}$$

11 #	r	t	DTW	SWL	s	W(u)	u	S
4-A	10'	100 min	17.40	4.92	12.48	9.42	4.55×10^{-5}	$2.92 \times 10^{-}$
6	77	100	11.50	3.15	7.15	5.85	1.6×10^{-3}	$1.74 \times 10^{-}$
5-A	585	70	6.70	4.92	1.78	1.34	1.7×10^{-1}	$2.24 \times 10^{-}$
3	1100	100	6.50	6.42	0.08	.06	3.6	$\boxed{1.91 \times 10^{-}}$

Average of First three

$$\frac{6.90}{3} = 2.3 \times 10^{-4}$$

~~27,000~~ 2,300 ft^2/d

For computation use $T = 17,300$ gpd/ft.

$S = 2.0 \times 10^{-4}$

Find well losses. Theoretical drawdown in PW #4 (assume $r_w = 1.33'$) is

$$\text{theoretical } s_w = \frac{264\,Q}{T} \log_{10} \frac{0.3\,T\,t}{r_w^2\,S}$$

$Q = 200$

$t = 60$ min $= .0417$ days.

$$\text{theoretical } s_w = \frac{(264)(200)}{17,300} \log_{10} \frac{(0.3)(17,300)(0.0417)}{(1.33^2)(2.0 \times 10^{-4})} = 17.7'$$

Actual s in PW #4 @ 60 min $= 43.1'$

well loss $= 43.1 - 17.7 = 25.4'$

Assume $CQ^2 \cong 25.4'$

$$C \cong 25.4'/Q^2 = \frac{25.4'}{200^2} = 6.35 \times 10^{-4}\ ft/gpm^2$$

6) Compute and plot interference figure for $Q = 200$ gpm, $t = 100$ days for one well, see lower part of Figure 2

Assume effective radius of actual wells to be $r_w = 1.0'$. theoretical drawdown $s_w = 28.7'$

interference from second well @ $r = 585'$

$s_I = 11.8$ ft

well losses $CQ^2 = 25.4'$

Actual drawdown in each of two wells pumping at 200 gpm each for 100 days with identical well losses

Actual $s_w = 28.7 + 11.8 + 25.4 = 65.9'$

PUMPING LEVEL in well # 4 = $65.9 + 5.0 = 70.9'$

NOTE: $PL = 71'$ is $11'$ below top of screen

7) Compute drawdowns in general vicinity of two wells pumping - use graphical computations. Plot contours on drawdown on Figure 3.

DISCUSSION

1) Time draw down curves indicate that some recharge is occurring as evidenced by reduction in slope of curves after about 200 minutes of pumping.

2) All figures used in computation are on conservative side meaning that drawdowns computed will be greater than actual.

3) Pumping 24 hrs / day for 100 days also is extreme case producing greater drawdowns than would normally occur with cyclic pumping.

For example, assume that each pump is pumping 12 hrs per day for 100 days. To be, again, conservative assume that the interference on each well from the other well $s_i = 11.8'$, the figure for continuous pumping. The drawdown in the pumping well would then be

$$s_w = \frac{114.6\,Q}{T}\left[W\left(\frac{u_{wr}}{f}\right) + 2.3\,F_1(m, f)\right] + CQ^2 + s_i \qquad *$$

$$u_{wr} = \frac{2693\, r_w^2 S}{T\, r}$$

$$s_w = \frac{(114.6)(200)}{17{,}300}\left[W\left\{\frac{(2693)(1^2)(2\times10^{-4})}{(17300)(1)(.5)}\right\} + (2.3)(1.0518)\right] + 25.4 + 11.8$$

$$s_w = (1.325)\left[(9.144) + (2.42)\right] + 25.4 + 11.8$$

$$s_w = 52.5' \qquad PL = 52.5' + 5.0' = 57.5'$$

* Ref: Jour of Hydraulics Div. ASCE, Nov. 1967 HY-6, # 5553

this computed pumping level is 2.5' above the top of the well screen. the figures are still conservative and therefore there is a factor of safety in the computed drawdown. the drawdowns with distance in the vicinity of the pumping wells would also be effected by cyclic pumping.

4) Concerning well loss — the well losses were computed by taking the actual drawdown in the pumping well and subtracting the computed theoretical drawdown. All well losses were assumed to be turbulent flow losses varying with the 2nd power of the pumping rate Q. these are assumptions only can can be verified by a step-drawdown test on each pumping well.

However, if the above assumptions are made, the well loss coefficient C is determined as $C = \frac{25.4}{200^2} = 6.35 \times 10^{-4}$ ft/gpm². this value is about 25 times as large as the coefficient normally considered representative of thoroughly developed wells ($c = 2.5 \times 10^{-5}$ ft/gpm²). Although this is only an indication and not a hard-and-fast rule, it does indicate that the pumping well #4 may improve with time.

5) From the above analysis, it appears that 200 gpm is the optimum design capacity for well #4.

6) All computations made assuming homogeneous, isotropic conditions. Field conditions may vary from assumptions.

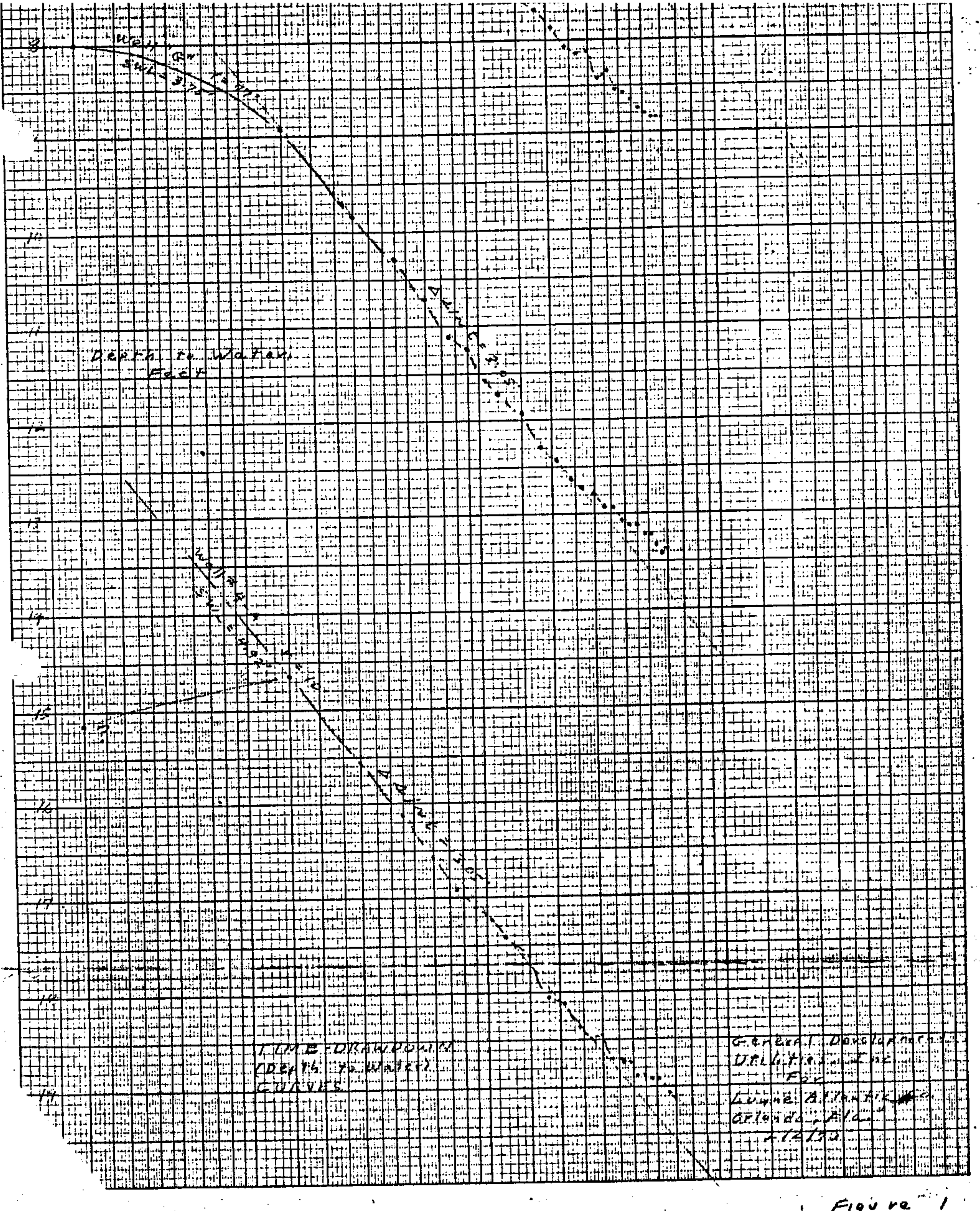
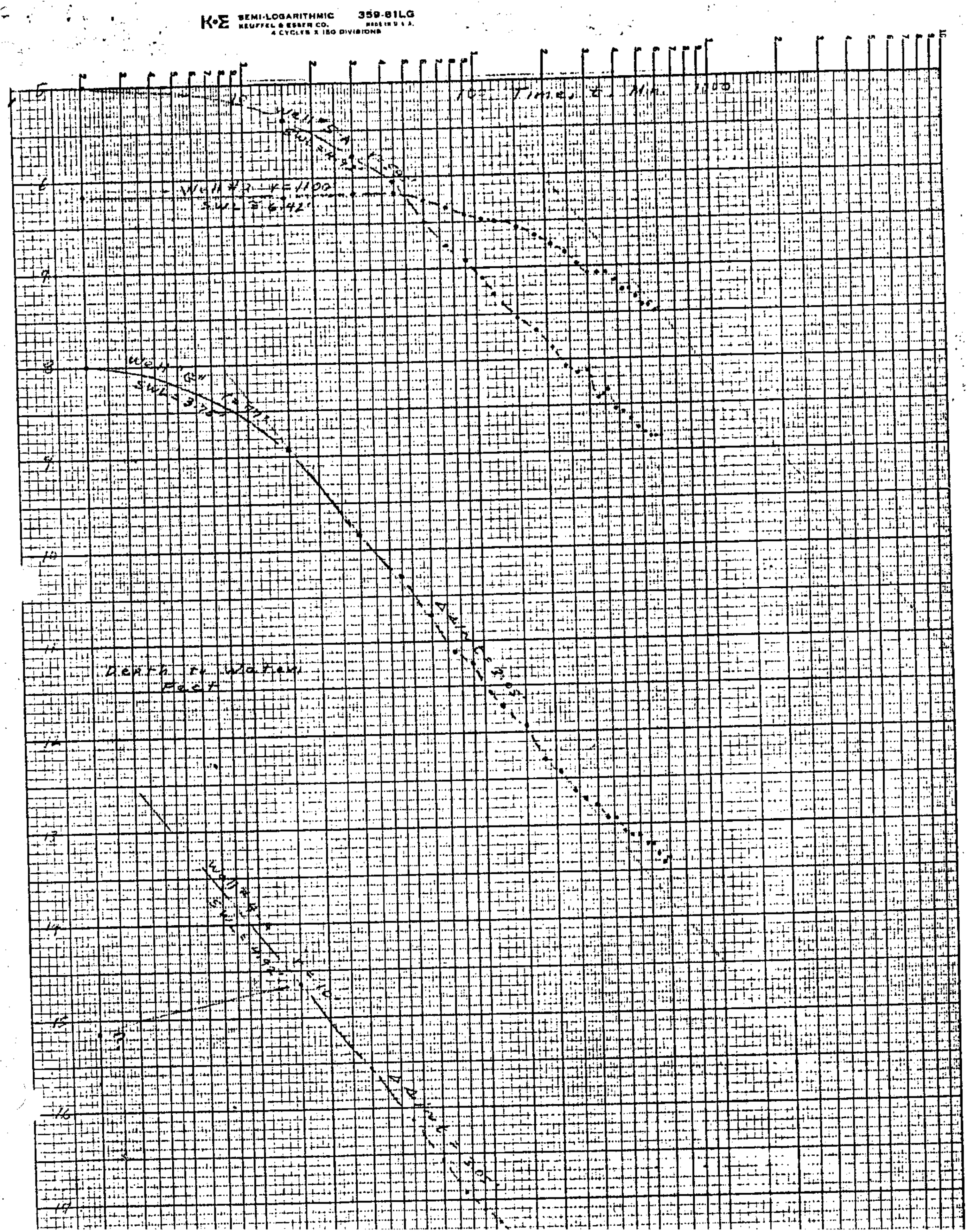

8
10
11
12
13
14
15
16
17
18
19
Depth to Water
Feet
Well #1
SWL = 3.7
Well #2
Δs
TIME-DRAWDOWN
(Depth to Water)
CURVES
General Development
Utilities Inc
For
Lowne Atlantic
Orlando, Fla.
1/12/59

Figure 1


K•E SEMI-LOGARITHMIC 359-81LG
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 180 DIVISIONS
10
10²
Time, t, Min.
1000
Well #5A
SWL=4.85'
Well #2 r=1100
SWL=6.42'
Well "G"
SWL=3.78'
Δs
Depth to Water Feet
Well #8
SWL=
r=10
Δs
5
6
7
8
9
10
11
12
13
14
15
16
17