CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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Drilling Time Log
Willen 1-28

Depth	Time		Time	
460 70	12 40	2:35	180 Min	2½ - truck
470 -80	2:35	2:46	11	
90	2:46	2 58	12	
500	2 58	3 14	16	
10	3:14	3:34	10	10 Conn
20	3:34	3:40	6	
30	3:40	3:50	10	20 conn mixed 3 Sks
40	3:50	4:21	11	Lime wouldn't go
50	4:21	4:28	7	
60	4:28	4:34	6	
70	4:34	4:44	7	3 Conn.
80	4:44	4:51	7	
90	4:51	4:58	7	
600	4 58	5:17	7	12 Min Circ to Make Conn
600 610	5:17	5:25	8	
20	5:25	5:34	9	
30	5:34	8:37	10	Shut down hite
40	8:37	8:55	18	
50	8:55	9:10	15	
60	9:10	9:31	11	10 conn.
70	9:31	9:42	11	
80	9:42	9:51	9	
90	9:51	10:03	8	4 conn
700	10:03	10:12	9	
10	10:12	10:25	13	
20	10:25	10:38	13	
30	10:38	10:55	13	4 conn
40	10:55	11:09	14	
50	11:09	11:24	15	
60	11:24	11:44	14	6 conn.
70	11:44	11:55	11	
80	11:55	12:07	12	
90	12:07	12:28	14	7 conn
790-800	12:28	12:42	14	

9:10-20	9:43-	10:08	25	
30	10:08	10:31	22	
40	10:31	10:50	16	5 conn
50	10:50	11:09	19	
60	11:09	11:28	19	
70	11:28	11:48	12	8 conn.
80	11:48	12:11	23	
90	12:11	12:33	22	
1:000	12:33 -	1:00	22	5 conn
10	1:00 -	1:30	22	
20	1:30 -	1:53	23	
30	1:53 -	2:22	24	5 conn
40	2:22 -	4:40	18	
50	4:40 -	2 58	18	
60	2:58 -	3:22	24	
70	3:22 -	3 58	31	5 conn.
80	3:58	4:31	33	
90	4:31	5:10	39	
11:00	5:10	5:47	32	5 conn.
10	5:47	6:25	28	
20	6:25	7:03	33	
30	7:23	7:46	38	5 conn
40	7:46	8:20	34	
50	8:20	8:54	34	
11:50-11:58	8:54	9:15	21	
70				

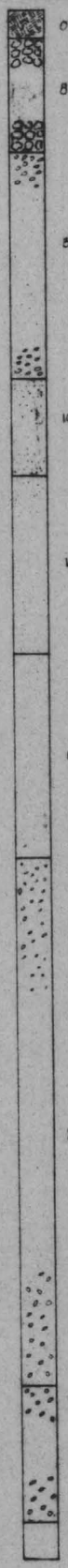
800-810	12:42	1:00	18	
20	12:00	1:25.	15	10 comm
30	1:25.	1:43	18	
40	1:43	1:58	15	
50	1:58	2:22	12	12 comm.
60	2:22	2:39	17	
70	2:39	2:55	14	
80	2:55	3:15	16	4 comm
90	3:15	3:24	9	
900	3:24	9:00	15	Waiting on cig.
10	9:20	9:43	18	5 comm
20	9:43			
30				
40				
50				

WELL Nº 7

SUNIZONA ACRES UNIT Nº 2 WELL LOG

CORNER-LOTS 85, 86, 91 & 92

SCALE: 1"=20'



DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-8	TOP SOIL
8-39	CLAY & BOULDERS
39-105	SAND GRAVEL & CLAY
105-130	RED SANDY CLAY - STRUCK WATER 108'
130-180	SAND LITTLE CLAY
180-237	FINE RED SAND - LITTLE CLAY
237-385	SAND GRAVEL, SOME CLAY
385-423	CEMENTED GRAVEL
423-433	ROCK, GRAY

NOTES

1. CASING - 12" I.D., ¼" WALL, PERFORATED 105' TO 432', MILLS KNIFE, 7-8 CUTS PER FOOT
2. STATIC WATER LEVEL BEFORE START OF PUMPING - 105'
3. SURGED WELL 18 HRS - TO SAND REMOVED
4. WHOLE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E ANDERSON
REG CIVIL ENGINEER
2549 E. BROADWAY
TUCSON ARIZ

JOB Nº 135

WELL Nº 7

SUNIZONA ACRES UNIT Nº 2 WELL LOG

CORNER - LOTS 88, 86, 91 & 92

SCALE: 1" = 20'

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-8	TOP SOIL
8-39	CLAY & BOULDERS
39-103	SAND, GRAVEL & CLAY
103-130	RED SANDY CLAY - STRUCK WATER 108'
130-180	SAND LITTLE CLAY
180-237	FINE RED SAND - LITTLE CLAY
237-385	SAND, GRAVEL, SOME CLAY
385-423	CEMENTED GRAVEL
423-433	ROCK, GRAY

NOTES

1- CASING - 12" I.D., ¼" WALL, PERFORATED 105' TO 432', MILLS KNIFE, 7-8 CUTS PER FOOT
2- STATIC WATER LEVEL BEFORE START OF PUMPING 105'
3- SURGED WELL 18 HRS - TO' SAND REMOVED
4- WHOLE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZ.

JOB Nº 135

WELL Nº 7

SUNIZONA ACRES UNIT Nº 2 WELL LOG

CORNER-LOTS 85, 86, 91 & 92

SCALE 1"=20'

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-8	TOP SOIL
8-39	CLAY & BOULDERS
39-103	SAND, GRAVEL & CLAY
103-130	RED SANDY CLAY - STRUCK WATER 108'
130-180	SAND LITTLE CLAY
180-237	FINE RED SAND - LITTLE CLAY
237-385	SAND, GRAVEL, SOME CLAY
385-423	CEMENTED GRAVEL
423-433	ROCK, GRAY

NOTES

1- CASING-12" I.D., ¼" WALL, PERFORATED 105' TO 423', MILLS KNIFE, 7-8 CUTS PER FOOT
2- STATIC WATER LEVEL BEFORE START OF PUMPING 105'
3- SURGED WELL 18 HRS.-TO SAND REMOVED
4- WHOLE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZ

JOB Nº 755

WELL N° 7

SUNIZONA ACRES UNIT N° 2 WELL LOG

CORNER-LOTS 85, 86, 91 & 92

SCALE: 1"=20'

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-8	TOP SOIL
8-89	CLAY & BOULDERS
89-105	SAND, GRAVEL & CLAY
105-130	RED SANDY CLAY - STRUCK WATER 108'
130-180	SAND LITTLE CLAY
180-237	FINE RED SAND - LITTLE CLAY
237-385	SAND, GRAVEL, SOME CLAY
385-423	CEMENTED GRAVEL
423-433	ROCK, GRAY

NOTES

1- CASING-12" I.D., ¼" WALL, PERFORATED 105' TO 431', MILLS KNIFE, 7-8 CUTS PER FOOT
2- STATIC WATER LEVEL BEFORE START OF PUMPING 105'
3- SURGED WELL 18 HRS -70' SAND REMOVED
4- WHOLE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZ

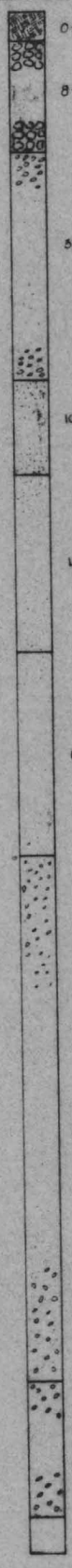
JOB N° 135

WELL Nº 7

SUNIZONA ACRES UNIT Nº 2 WELL LOG

CORNER-LOTS 85, 86, 91 & 92

SCALE: 1"=20'



DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-8	TOP SOIL
8-39	CLAY & BOULDERS
39-103	SAND GRAVEL & CLAY
103-130	RED SANDY CLAY - STRUCK WATER 108'
130-180	SAND LITTLE CLAY
180-237	FINE RED SAND - LITTLE CLAY
237-385	SAND GRAVEL, SOME CLAY
385-423	CEMENTED GRAVEL
423-463	ROCK, GRAY

NOTES

1- CASING - 12" I.D., ¼" WALL, PERFORATED 105' TO 432', MILLS KNIFE, 7-8 CUTS PER FOOT
2- STATIC WATER LEVEL BEFORE START OF PUMPING - 105'
3- SURGED WELL 18 HRS. - TO SAND REMOVED
4- WHOLE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E ANDERSON
REG CIVIL ENGINEER
2549 E BROADWAY
TUCSON, ARIZ

JOB Nº 755

WELL N° 8

SUNIZONA ACRES UNIT N° 2 - WELL LOG

SCALE: 1"=20'

INTERSECTION - LOTS 117, 118, 123, & 124

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-7	CLAY
7-15	GRAVEL
15-42	CLAY
42-52	RED CLAY
52-80	SANDY CLAY
80-90	SANDY CLAY
90-100	GRAVELY CLAY
100-110	GRAVELY CLAY
110-115	SMALL GRAVEL (FIRST WATER)
115-140	SANDY CLAY
140-142	COARSE GRAVEL (WATER)
142-166	GRAVELY CLAY
166-168	SAND & GRAVEL (WATER)
168-200	SANDY CLAY
200-202	GRAVEL (WATER)
202-253	SANDY CLAY
253-257	COARSE GRAVEL (WATER)
257-298	SANDY CLAY
298-310	SAND
310-338	SANDY CLAY
338-342	COARSE GRAVEL & SAND (WATER)
342-353	CLAY & CONGLOMERATE ROCK

NOTES

1. CASING PERFORATED 140' TO 353' - 8 1'-0" x 0' 3/16" CUTS PER FOOT
2. ENCOUNTERED FIRST WATER AT 110' WATER LEVEL REMAINED AT 110' TILL 255' DEPTH WAS REACHED, THEN ROSE TO 108' & REMAINED THERE
3. WASHED A GREAT DEAL OF FINE SAND FROM 298' 310' LEVEL

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
MAY 5, 1961

JOB N° 195

WELL Nº 8

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

SCALE: 1" = 20'

INTERSECTION - LOTS 117, 118, 123, & 124

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-7	CLAY
7-15	GRAVEL
15-42	CLAY
42-52	RED CLAY
52-80	SANDY CLAY
80-90	SANDY CLAY
90-100	GRAVELY CLAY
100-110	GRAVELY CLAY
110-115	SMALL GRAVEL (FIRST WATER)
115-140	SANDY CLAY
140-142	COARSE GRAVEL (WATER)
142-166	GRAVELY CLAY
166-168	SAND & GRAVEL (WATER)
168-200	SANDY CLAY
200-202	GRAVEL (WATER)
202-253	SANDY CLAY
253-257	COARSE GRAVEL (WATER)
257-298	SANDY CLAY
298-310	SAND
310-338	SANDY CLAY
338-342	COARSE GRAVEL & SAND (WATER)
342-353	CLAY & CONGLOMERATE ROCK

NOTES:

1. CASING PERFORATED 140' TO 353' - 3 1'-0" x 0' 3/16" CUTS PER FOOT
2. ENCOUNTERED FIRST WATER AT 110' WATER LEVEL REMAINED AT 110' TILL 255' DEPTH WAS REACHED, THEN ROSE TO 105 & REMAINED THERE
3. WASHED A GREAT DEAL OF FINE SAND FROM 298' 310' LEVEL

PREPARED BY:
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
MAY 5, 1961

JOB Nº 135

WELL Nº 8

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

SCALE: 1" = 20'

INTERSECTION - LOTS 117, 118, 123, & 124

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-7	CLAY
7-15	GRAVEL
15-42	CLAY
42-52	RED CLAY
52-80	SANDY CLAY
80-90	SANDY CLAY
90-100	GRAVELY CLAY
100-110	GRAVELY CLAY
110-115	SMALL GRAVEL (FIRST WATER)
115-140	SANDY CLAY
140-142	COARSE GRAVEL (WATER)
142-166	GRAVELY CLAY
166-168	SAND & GRAVEL (WATER)
168-200	SANDY CLAY
200-202	GRAVEL (WATER)
202-253	SANDY CLAY
253-257	COARSE GRAVEL (WATER)
257-298	SANDY CLAY
298-310	SAND
310-338	SANDY CLAY
338-342	COARSE GRAVEL & SAND (WATER)
342-353	CLAY & CONGLOMERATE ROCK

NOTES:

1. CASING PERFORATED 140' TO 353' - 3-1'-0" X 0 3/16" CUTS PER FOOT
2. ENCOUNTERED FIRST WATER AT 110' WATER LEVEL REMAINED AT 110' TILL 255' DEPTH WAS REACHED, THEN ROSE TO 105' & REMAINED THERE
3. WASHED A GREAT DEAL OF FINE SAND FROM 298' 310' LEVEL

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
MAY 5, 1961

JOB Nº 135

WELL Nº 8

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

SCALE: 1" = 20'

INTERSECTION - LOTS 117, 118, 123, & 124

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-7	CLAY
7-15	GRAVEL
15-42	CLAY
42-52	RED CLAY
52-80	SANDY CLAY
80-90	SANDY CLAY
90-100	GRAVELY CLAY
100-110	GRAVELY CLAY
110-115	SMALL GRAVEL (FIRST WATER)
115-140	SANDY CLAY
140-142	COARSE GRAVEL (WATER)
142-166	GRAVELY CLAY
166-168	SAND & GRAVEL (WATER)
168-200	SANDY CLAY
200-202	GRAVEL (WATER)
202-253	SANDY CLAY
253-257	COARSE GRAVEL (WATER)
257-298	SANDY CLAY
298-310	SAND
310-338	SANDY CLAY
338-342	COARSE GRAVEL & SAND (WATER)
342-353	CLAY & CONGLOMERATE ROCK

NOTES:

1. CASING PERFORATED 140' TO 353' - 3 1-0" x 0' 3/16" CUTS PER FOOT
2. ENCOUNTERED FIRST WATER AT 110' WATER LEVEL REMAINED AT 110' TILL 255' DEPTH WAS REACHED, THEN ROSE TO 105' & REMAINED THERE
3. WASHED A GREAT DEAL OF FINE SAND FROM 298' - 310' LEVEL

PREPARED BY:
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
MAY 5, 1961

JOB Nº 735

WELL Nº 9

SUNIZONA ACRES UNIT Nº2 WELL LOG

SCALE 1"=20'

CORNER LOTS 113, 114, 127 & 128

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-7	TOP SOIL
7-22	CLAY & BOULDERS
22-27	RED CLAY
27-55	CLAY & BOULDERS
55-103	RED SANDY CLAY
103-175	CLAY & GRAVEL
175-218	RED SANDY CLAY - FINE SAND
218-315	RED SANDY CLAY - STICKY
315-345	RED CLAY & GRAVEL
345-367	RED HARD CONGLOMERATE - RED ROCK
367-392	CEMENTED BOULDERS - RED ROCK

Notes

1. CASING PERFORATED 122' TO 392', 4 CUTS STAGGERED - 12" x ⅜", 18" RINGS
2. STATIC WATER LEVEL - 120'

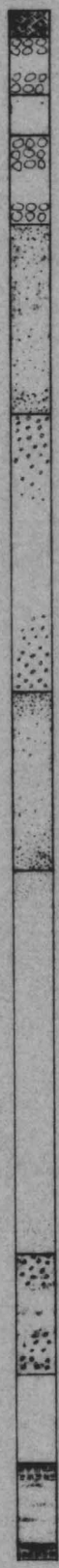
PREPARED BY
GENE E ANDERSON
REG. CIVIL ENGINEER
2548 E BROADWAY
TUCSON, ARIZONA
JULY 29, 1961

WELL No 9

SUNIZONA ACRES UNIT No 2 WELL LOG

SCALE 1" = 20'

CORNER LOTS 113, 114, 127 & 128



DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-7	TOP SOIL
7-22	CLAY & BOULDERS
22-27	RED CLAY
27-55	CLAY & BOULDERS
55-103	RED SANDY CLAY
103-175	CLAY & GRAVEL
175-218	RED SANDY CLAY - FINE SAND
218-315	RED SANDY CLAY - STICKY
315-345	RED CLAY & GRAVEL
345-367	RED HARD CONGLOMERATE - RED ROCK
367-392	CEMENTED BOULDERS - RED ROCK

Notes

1. CASING PERFORATED 122' TO 392', 4 CUTS STAGGERED - 12" x 5", 12" RINGS
2. STATIC WATER LEVEL - 120'

PREPARED BY
GENE E ANDERSON
REG. CIVIL ENGINEER
2349 E BROADWAY
TUCSON, ARIZONA
JULY 29, 1961

WELL Nº 9

SUNIZONA ACRES UNIT Nº2 WELL LOG

SCALE 1"=20'

CORNER LOTS 113, 114, 129 & 128

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-7	TOP SOIL
7-22	CLAY & BOULDERS
22-27	RED CLAY
27-55	CLAY & BOULDERS
55-103	RED SANDY CLAY
103-175	CLAY & GRAVEL
175-218	RED SANDY CLAY - FINE SAND
218-315	RED SANDY CLAY - STICKY
315-345	RED CLAY & GRAVEL
345-367	RED HARD CONGLOMERATE - RED ROCK
367-392	CEMENTED BOULDERS - RED ROCK

Notes

1. CASING PERFORATED 122' TO 392', 4 CUTS STAGGERED - 12"x⅜", 12" RINGS
2. STATIC WATER LEVEL - 120'

PREPARED BY
GENE E ANDERSON
REG. CIVIL ENGINEER
2549 E BROADWAY
TUCSON, ARIZONA
JULY 29, 1961

WELL Nº 9

SUNIZONA ACRES UNIT Nº2 WELL LOG

SCALE 1"=20'

CORNER LOTS 113, 114, 127 & 128

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-7	TOP SOIL
7-22	CLAY & BOULDERS
22-27	RED CLAY
27-55	CLAY & BOULDERS
55-103	RED SANDY CLAY
103-175	CLAY & GRAVEL
175-218	RED SANDY CLAY - FINE SAND
218-315	RED SANDY CLAY - STICKY
315-345	RED CLAY & GRAVEL
345-367	RED HARD CONGLOMERATE - RED ROCK
367-392	CEMENTED BOULDERS - RED ROCK

Notes

1. CASING PERFORATED 122' TO 392', 4 CUTS STAGGERED - 12" x ⅝", 12" RINGS
2. STATIC WATER LEVEL - 120'

PREPARED BY:
GENE E ANDERSON
REG. CIVIL ENGINEER
2949 E BROADWAY
TUCSON, ARIZONA
JULY 29, 1961

WELL Nº 9

SUNIZONA ACRES UNIT Nº2 WELL LOG

SCALE 1"=20'

CORNER LOTS 113, 114, 127 & 128

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-7	TOP SOIL
7-22	CLAY & BOULDERS
22-27	RED CLAY
27-55	CLAY & BOULDERS
55-103	RED SANDY CLAY
103-175	CLAY & GRAVEL
175-218	RED SANDY CLAY - FINE SAND
218-315	RED SANDY CLAY - STICKY
315-345	RED CLAY & GRAVEL
345-367	RED HARD CONGLOMERATE - RED ROCK
367-392	CEMENTED BOULDERS - RED ROCK

Notes

1. CASING PERFORATED 122' TO 392', 4 CUTS STAGGERED - 12" x 5", 18" RINGS
2. STATIC WATER LEVEL - 120'

PREPARED BY
GENE E ANDERSON
REG. CIVIL ENGINEER
7349 E BROADWAY
TUCSON, ARIZONA
JULY 29, 1961

WELL Nº 5

SUNIZONA ACRES UNIT Nº 2

SCALE 1"=20'

INTERSECTION - LOTS 19, 74, 77, 78

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-9	CLAY & GRAVEL
9-37	CEMENTED BOULDERS
37-43	CLAY & GRAVEL
43-49	RED SANDY CLAY
49-80	CLAY & GRAVEL
80-125	RED SANDY CLAY - STRUCK WATER at 120'
125-213	FINE SAND - LITTLE CLAY
213-335	RED SANDY CLAY
335-390	SANDY GRAVEL - LITTLE CAVEY
390-400	YELLOW SANDSTONE

NOTES

1. CASING PERFORATED 120' TO 985' MILLS KNIFE 1-8 CUTS PER FOOT
2. STATIC WATER LEVEL - 130'
3. ENTIRE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E ANDERSON
REG CIVIL ENGINEER
2549 E BROADWAY
TUCSON, ARIZONA

JOB Nº 765

WELL No 5

SUNIZONA ACRES UNIT No 2

SCALE 1"=20'

INTERSECTION - LOTS 29, 74, 77, 78

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-9	CLAY & GRAVEL
9-37	CEMENTED BOULDERS
37-43	CLAY & GRAVEL
43-49	RED SANDY CLAY
49-80	CLAY & GRAVEL
80-125	RED SANDY CLAY - STRUCK WATER at 120'
125-213	FINE SAND - LITTLE CLAY
213-335	RED SANDY CLAY
335-390	SANDY GRAVEL - LITTLE CAVEY
390-400	YELLOW SANDSTONE

NOTES

1. CASING PERFORATED 120' TO 985' MILLS KNIFE, 1-8 CUTS PER FOOT
2. STATIC WATER LEVEL - 120'
3. ENTIRE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA

JOB No 755

WELL Nº 5

SUNIZONA ACRES UNIT Nº 2

SCALE 1"=10'

INTERSECTION - LOTS 73, 74, 77, 78

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-9	CLAY & GRAVEL
9-37	CEMENTED BOULDERS
37-43	CLAY & GRAVEL
43-49	RED SANDY CLAY
49-80	CLAY & GRAVEL
80-125	RED SANDY CLAY - STRUCK WATER at 120'
125-213	FINE SAND - LITTLE CLAY
213-335	RED SANDY CLAY
335-390	SANDY GRAVEL - LITTLE CAVEY
390-400	YELLOW SANDSTONE

NOTES

1. CASING PERFORATED 120' TO 985', MILLS KNIFE, 1-8 CUTS PER FOOT
2. STATIC WATER LEVEL - 120'
3. ENTIRE WELL DRILLED OPEN HOLE

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA

JOB Nº 755

WELL Nº 5

SUNIZONA ACRES UNIT Nº 2

SCALE: 1"=10'

INTERSECTION - LOTS 75, 76, 77, 78

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-9	CLAY & GRAVEL
9-37	CEMENTED BOULDERS
37-43	CLAY & GRAVEL
43-49	RED SANDY CLAY
49-80	CLAY & GRAVEL
80-125	RED SANDY CLAY - STRUCK WATER at 120'
125-213	FINE SAND - LITTLE CLAY
213-335	RED SANDY CLAY
335-390	SANDY GRAVEL - LITTLE CAVEY
390-400	YELLOW SANDSTONE

NOTES:

1. CASING PERFORATED 120' TO 385' MILLS KNIFE, 1-8 CUTS PER FOOT
2. STATIC WATER LEVEL - 120'
3. ENTIRE WELL DRILLED OPEN HOLE

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SCALE: 1"=10'

INTERSECTION - LOTS 75, 76, 77, 78

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-4	TOP SOIL
4-9	CLAY & GRAVEL
9-37	CEMENTED BOULDERS
37-43	CLAY & GRAVEL
43-49	RED SANDY CLAY
49-80	CLAY & GRAVEL
80-125	RED SANDY CLAY - STRUCK WATER at 120'
125-213	FINE SAND - LITTLE CLAY
213-335	RED SANDY CLAY
335-390	SANDY GRAVEL - LITTLE CAVEY
390-400	YELLOW SANDSTONE

NOTES

1. CASING PERFORATED 120' TO 385' MILLS KNIFE, 3-8 CUTS PER FOOT
2. STATIC WATER LEVEL - 120'
3. BOTTOM WELL DRILLED OPEN HOLE

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA

JOB Nº 195

WELL No 6

SUNIZONA ACRES UNIT No 2 - WELL LOG

INTERSECTION - LOTS 31, 32, 33 & 36

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-5	SANDY LOAM TOP SOIL
5-10	CLEAN GRAVEL
10-20	GRAVELY CLAY
20-70	RED CLAY
70-80	GRAVELY CLAY
80-110	GRAVELY CLAY
110-120	SANDY CLAY
120-125	FINE SAND (WATER)
125-130	ROCKY RED CLAY
130-140	" "
140-145	COARSE GRAVEL & SAND
145-180	SANDY CLAY
180-185	GRAVEL & SAND (WATER)
185-200	SANDY CLAY
200-220	ROCKY CLAY
220-240	SANDY CLAY
240-245	CLAY & ROCK
245-250	GRAVEL & SAND (WATER)
250-270	SANDY CLAY
270-275	SMALL GRAVEL (WATER)
275-295	SANDY CLAY
295-296	GRAVEL & SAND (WATER)
296-368	SANDY CLAY
368-361	SMALL GRAVEL, FINE SAND (WATER)
361-380	SANDY CLAY
380-385	COARSE GRAVEL (WATER)
385-390	SANDY CLAY
390-405	CLAY
405-408	STICKY CLAY
408-445	LIGHT PURPLE CONGLOMERATE
440-445	BELIEVED TO BE WATER
445-504	ROCK

USGS LOG

405-445	GRAVELY SAND
445-504	MUDDY GRAVELY SAND PROBABLY NOT WATER YIELDING

NOTES:

1. 12" I.D. CASING FROM SURFACE TO 405' PERFORATED FROM 13.4' TO 400' WITH 3-1'-0" x 0'-3/16" CUTS PER FOOT. 10" I.D. CASING FROM 400' TO 504' PERFORATED FULL LENGTH - 2-1'-0" x 0'-3/16" CUTS PER FOOT, 4 CUTS AROUND
2. FIRST WATER ENCOUNTERED AT 120'. AT SECOND ENCOUNTER (140'-145') WATER LEVEL ROSE TO 115, REMAINED THERE TILL DEPTH OF 245'-250' WAS REACHED, THEN ROSE TO 110'± REMAINED THERE.
3. MOST ACTIVE FORMATION WAS AT 358'-361' DEPTH. WASHED A GREAT DEAL OF MATERIAL FROM THIS LEVEL.

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
JULY 9, 1961

JOB No 795

WELL Nº 6

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

INTERSECTION - LOTS 81, 82, 95 & 96

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-3	SANDY LOAM TOP SOIL
3-10	CLEAN GRAVEL
10-20	GRAVELY CLAY
20-70	RED CLAY
70-80	GRAVELY CLAY
80-110	GRAVELY CLAY
110-120	SANDY CLAY
120-125	FINE SAND (WATER)
125-130	ROCKY RED CLAY
130-140	" "
140-145	COARSE GRAVEL & SAND
145-180	SANDY CLAY
180-185	GRAVEL & SAND (WATER)
185-200	SANDY CLAY
200-220	ROCKY CLAY
220-240	SANDY CLAY
240-245	CLAY & ROCK
245-250	GRAVEL & SAND (WATER)
250-270	SANDY CLAY
270-275	SMALL GRAVEL (WATER)
275-295	SANDY CLAY
295-296	GRAVEL & SAND (WATER)
296-365	SANDY CLAY
365-361	SMALL GRAVEL, FINE SAND (WATER)
361-380	SANDY CLAY
380-385	COARSE GRAVEL (WATER)
385-390	SANDY CLAY
390-405	CLAY
405-408	STICKY CLAY
408-445	LIGHT PURPLE CONGLOMERATE
440-445	BELIEVED TO BE WATER
445-504	ROCK

U.S.G.S. LOG

405-445	GRAVELY SAND
445-504	MUDDY GRAVELY SAND PROBABLY NOT WATER YIELDING

NOTES:

1. 12" I.D. CASING FROM SURFACE TO 405' PERFORATED FROM 198'-11" TO 400' WITH 3-1'-0" x 0'-3/16" CUTS PER FOOT. 10" I.D. CASING FROM 400' TO 504' PERFORATED FULL LENGTH 2-1'-0" x 0'-3/16" CUTS PER FOOT, 6 CUTS AROUND
2. FIRST WATER ENCOUNTERED AT 120'. AT SECOND ENCOUNTER (140'-145') WATER LEVEL ROSE TO 115, REMAINED THERE TILL DEPTH OF 245-250' WAS REACHED, THEN ROSE TO 110'± REMAINED THERE.
3. MOST ACTIVE FORMATION WAS AT 358-361 DEPTH. WASHED A GREAT DEAL OF MATERIAL FROM THIS LEVEL.

PREPARED BY
GENE L. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
JULY 9, 1961

JOB Nº 795

WELL Nº 6

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

INTERSECTION: LOTS 31, 32, 33 & 36

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-5	SANDY LOAM TOP SOIL
5-10	CLEAN GRAVEL
10-20	GRAVELY CLAY
20-70	RED CLAY
70-80	GRAVELY CLAY
80-110	GRAVELY CLAY
110-120	SANDY CLAY
120-125	FINE SAND (WATER)
125-130	ROCKY RED CLAY
130-140	" " "
140-145	COARSE GRAVEL & SAND
145-180	SANDY CLAY
180-185	GRAVEL & SAND (WATER)
185-200	SANDY CLAY
200-220	ROCKY CLAY
220-240	SANDY CLAY
240-245	CLAY & ROCK
245-250	GRAVEL & SAND (WATER)
250-270	SANDY CLAY
270-275	SMALL GRAVEL (WATER)
275-295	SANDY CLAY
295-296	GRAVEL & SAND (WATER)
296-365	SANDY CLAY
365-361	SMALL GRAVEL FINE SAND (WATER)
361-380	SANDY CLAY
380-385	COARSE GRAVEL (WATER)
385-390	SANDY CLAY
390-405	CLAY
405-408	STICKY CLAY
408-445	LIGHT PURPLE CONGLOMERATE
440-445	BELIEVED TO BE WATER
445-504	ROCK

U.S.G.S. LOG	
405-445	GRAVELY SAND
445-504	MUDDY GRAVELY SAND PROBABLY NOT WATER YIELDING

NOTES:

1. 12" I.D. CASING FROM SURFACE TO 405' PERFORATED FROM 134'-11" TO 400' WITH 3-1'-0" x 0-3/16" CUTS PER FOOT. 10" I.D. CASING FROM 400' TO 504' PERFORATED FULL LENGTH - 2-1'-0" x 0-3/16" CUTS PER FOOT, 4 CUTS AROUND
2. FIRST WATER ENCOUNTERED AT 120'. AT SECOND ENCOUNTER (140'-145') WATER LEVEL ROSE TO 115', REMAINED THERE TILL DEPTH OF 245'-250' WAS REACHED. THEN ROSE TO 110' & REMAINED THERE.
3. MOST ACTIVE FORMATION WAS AT 358'-361' DEPTH. WASHED A GREAT DEAL OF MATERIAL FROM THIS LEVEL.

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
JULY 9, 1961

JOB Nº 735

WELL Nº 6

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

INTERSECTION - LOTS 81, 82, 83 & 86

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-5	SANDY LOAM TOP SOIL
5-10	CLEAN GRAVEL
10-20	GRAVELY CLAY
20-70	RED CLAY
70-80	GRAVELY CLAY
80-110	GRAVELY CLAY
110-120	SANDY CLAY
120-125	FINE SAND (WATER)
125-130	ROCKY RED CLAY
130-140	" " "
140-145	COARSE GRAVEL & SAND
145-180	SANDY CLAY
180-185	GRAVEL & SAND (WATER)
185-200	SANDY CLAY
200-220	ROCKY CLAY
220-240	SANDY CLAY
240-245	CLAY & ROCK
245-250	GRAVEL & SAND (WATER)
250-270	SANDY CLAY
270-275	SMALL GRAVEL (WATER)
275-295	SANDY CLAY
295-296	GRAVEL & SAND (WATER)
296-368	SANDY CLAY
368-361	SMALL GRAVEL FINE SAND (WATER)
361-380	SANDY CLAY
380-388	COARSE GRAVEL (WATER)
388-390	SANDY CLAY
390-408	CLAY
408-408	STICKY CLAY
408-445	LIGHT PURPLE CONGLOMERATE
440-445	BELIEVED TO BE WATER
445-504	ROCK

U.S.G.S. LOG	
405-445	GRAVELY SAND
445-504	MUDDY GRAVELY SAND PROBABLY NOT WATER YIELDING

NOTES:

1. 12" I.D. CASING FROM SURFACE TO 405' PERFORATED FROM 194'-11" TO 400' WITH 3-1'-0" x 0 3/16" CUTS PER FOOT. 10" I.D. CASING FROM 400' TO 504' PERFORATED FULL LENGTH - 2-1'-0" x 0 3/16" CUTS PER FOOT, 4 CUTS AROUND
2. FIRST WATER ENCOUNTERED AT 120'. AT SECOND ENCOUNTER (140'-145') WATER LEVEL ROSE TO 115', REMAINED THERE TILL DEPTH OF 245'-250' WAS REACHED, THEN ROSE TO 110'± REMAINED THERE.
3. MOST ACTIVE FORMATION WAS AT 358' 361' DEPTH. WASHED A GREAT DEAL OF MATERIAL FROM THIS LEVEL.

PREPARED BY
GENE E. ANDERSON
REG. CIVIL ENGINEER
2549 E. BROADWAY
TUCSON, ARIZONA
JULY 7 1961

JOB Nº 755

WELL Nº 6

SUNIZONA ACRES UNIT Nº 2 - WELL LOG

INTERSECTION - LOTS 81, 82, 83 & 86

DEPTH BELOW SURFACE IN FEET	TYPE OF FORMATION
0-5	SANDY LOAM TOP SOIL
5-10	CLEAN GRAVEL
10-20	GRAVELY CLAY
20-70	RED CLAY
70-80	GRAVELY CLAY
80-110	GRAVELY CLAY
110-120	SANDY CLAY
120-125	FINE SAND (WATER)
125-130	ROCKY RED CLAY
130-140	" " "
140-145	COARSE GRAVEL & SAND
145-180	SANDY CLAY
180-185	GRAVEL & SAND WATER
185-200	SANDY CLAY
200-220	ROCKY CLAY
220-240	SANDY CLAY
240-245	CLAY & ROCK
245-250	GRAVEL & SAND (WATER)
250-270	SANDY CLAY
270-275	SMALL GRAVEL (WATER)
275-295	SANDY CLAY
295-296	GRAVEL & SAND (WATER)
296-368	SANDY CLAY
368-361	SMALL GRAVEL FINE SAND (WATER)
361-380	SANDY CLAY
380-389	COARSE GRAVEL (WATER)
389-390	SANDY CLAY
390-409	CLAY
409-408	STICKY CLAY
408-445	LIGHT PURPLE CONGLOMERATE
440-445	BELIEVED TO BE WATER
445-504	ROCK

U.S.G.S. LOG	
405-445	GRAVELY SAND
445-504	MUDDY GRAVELY SAND PROBABLY NOT WATER YIELDING

NOTES:

1. 12" I.D. CASING FROM SURFACE TO 405' PERFORATED FROM 198'-11" TO 400' WITH 3-1'-0" x 0'-3/16" CUTS PER FOOT. 10" I.D. CASING FROM 400' TO 504' PERFORATED FULL LENGTH - 2-1'-0" x 0'-3/16" CUTS PER FOOT, 4 CUTS AROUND.
2. FIRST WATER ENCOUNTERED AT 120'. AT SECOND ENCOUNTER (140'-145') WATER LEVEL ROSE TO 115, REMAINED THERE TILL DEPTH OF 245'-250' WAS REACHED. THEN ROSE TO 110'± REMAINED THERE.
3. MOST ACTIVE FORMATION WAS AT 358'-361' DEPTH. WASHED A GREAT DEAL OF MATERIAL FROM THIS LEVEL.

PREPARED BY
GENE L. ANDERSON
REG. CIVIL ENGINEER
2949 E. BROADWAY
TUCSON, ARIZONA
JULY 9, 1961

JOB Nº 795

Dick -

I run off with your copy -

Made the plane OK with 1 min to spare.

- Mary

SEP 1965
GEOEX

WILLEN CORPORATION

Sunizona Well, Sec 28, Deepening

Liner Program Detail.

Present Status:

16" casing, 1/4" wall with shoe at 390' (D.F. Datum 5' above grd.)
15" hole drilled to 1154'. 16" casing perf 185'-380'

Liner Program Detail

Run 12 3/4" OD, 33#, bevel end casing on 5" drill pipe as follows:

Bottom	3 joints	perf.	121'	±	M.C. 1/8" slots 8 Rows
Next	2 "	blank	80'		
"	1 "	perf	40'		"
"	2 "	blank	80'		
"	6 "	perf	242'		"
"	2 "	blank	80'		
"	1 "	perf	40'		T.C. 1/8" slots 8 Rows
"	2 1/2 "	blank	97	±	
	19 1/2 "		780'		

Circulate for clear returns before backing off drill pipe from liner.

McEastman
9/1/65

perforations in 12 3/4" are at -
472-512, 592-834, 914-954, 1034-1155 (actual 9/2/65)
McE

Orig. compl. - Cased to 390', drilled 15" to 502 (Anderson found 455' T.D.) Perf. 185'-380'

September 7, 1965

Sample Description from Willen Well 1 - 28
NE 1/4, NE 1/4, Sec. 28, T 17 S, R 27 E.

Depth	Description
470'	Sd, m, ang-subrd, calc,60%; Andesite, rock chips blk, 30%; mnr small qtz cryst.; Rhyolite, rock chips, red, 10%.
480'-490'	Sd, 10%; Andesite, 30%; Rhyolite 20%, as abv; Ss,f, w rdd, clyey, 40%.
500-530'	Sd, 80%; Andesite and Rhyolite, as abv, 20%; mnr wh rock chips, (tuff?)
540-560'	Cgl, rock frag w/s rdd edges (stream worn?), volc and meta, 100%.
570'	Sd, crs-v crs, rdd-w rdd, 50%; Cgl, as abv 50%
580-590'	Sd, 50% & Ss, 10%, as at 480'; Cgl, as abv, 40%
600-640'	Cgl, as at 540'.
650-690'	Cgl, as at 540', 50%-80%; Ss, brn, f, some calc cem (caliche?) takes water, 50%-20%; mnr sh at 680'
700'	Cgl, as abv, 40%; Ss, as abv, 20%; Cly, sdy, brn, calc, 20%
710-750'	Cgl, as abv 60-80%; Ss, as abv, 30-20%; Epidote frag., 10%, at 710' and 720'
760'	Cgl, as abv 70%; Sd, m-crs, rdd-w rdd, 30%
770-810'	Cgl, (as abv), rock frag w/some rdd corners, rhyolite, andesite, qtzt, granite and other igneous and meta rocks.
820-840'	Cgl, as abv, 50%; Sd, as at 710', 50% (Cgl becomes finer gr at 840')
850'	Cgl, as abv, 30%; Sd, f-m, ang-rdd, p. srtd, 70%
860-880'	Cgl, as abv, 80%; Sd, as abv, 20%
890-1000'	No samples.
1010'	Cgl, as abv, 40%; Sd, f-m, sbang-sbrd, (looks good for water) 60%
1020-1040'	Sd, crs-v crs, sbrd-w rdd, 70%-30%, Cgl, 2-4mm, vol., 30%-70%
1050'	Sd, f-m w/s v crs; sbang - rdd, Labradorite gr. (good water?)
1060' fm change	Cgl, 2-5mm, w rdd peb, some frag crsr matl; Mnr sd, as abv. fm change.
1070'	Cgl, as at 1010', 30%; Rhyolite, lt gry, qtz pheno crysts, frag labradorite, 70%
1080-1090'	Rhyolite, as abv, 20%; Sd, f-m, ang-subrd, poss good water, 80%.
1100'	Cgl, as at 1010', 40%; Rhyolite, as at 1070, 60%
1110'	Cgl, as at 1010', 20%; Rhyolite, as at 1070, 50%; sd, crs, ang-subrd, 30%; Mnr Ss, wht, f, w rdd, prob. cavings.
1120'-1150'	Rhyolite, as at 1070, 20%-50%; Sd, as at 1080', 50%-80%. Ss, brn f-m, slty, w rdd, at 1130' 10%.

Drilled with rotary rig. Samples from return pipe. Depths from top of rig floor 5 ft. above ground surface. Drilled to 455', cased and completed in spring 1965. Drilled from 455' to total depths of 1010' and E-logged in August 1965.

September 7, 1965

Sample Description from Willen Well 1 - 28
NE 1/4, NE 1/4, Sec. 28, T 17 S, R 27 E.

Depth	Description
470'	Sd, m, ang-subrd, calc,60%; Andesite, rock chips blk, 30%; mnr small qtz cryst.; Rhyolite, rock chips, red, 10%.
480'-490'	Sd, 10%; Andesite, 30%; Rhyolite 20%, as abv; Ss,f, w rdd, clyey, 40%.
500-530'	Sd, 80%; Andesite and Rhyolite, as abv, 20%; mnr wh rock chips, (tuff?)
540-560'	Cgl, rock frag w/s rdd edges (stream worn?), volc and meta, 100%.
570'	Sd, crs-v crs, rdd-w rdd, 50%; Cgl, as abv 50%
580-590'	Sd, 50% & Ss, 10%, a at 480'; Cgl, as abv, 40%
600-640'	Cgl, as at 540'.
650-690'	Cgl, as at 540', 50%-80%; Ss, brn, f, some calc cem (caliche?) takes water, 50%-20%; mnr sh at 680'
700'	Cgl, as abv, 40%; Ss, as abv, 20%; Cly, sdy, brn, calc, 20%
710-750'	Cgl, as abv 60-80%; Ss, as abv, 30-20%; Epidote frag., 10%, at 710' and 720'
760'	Cgl, as abv 70%; Sd, m-crs, rdd-w rdd, 30%
770-810'	Cgl, (as abv), rock frag w/some rdd corners, rhyolite, andesite, qtzt, granite and other igneous and meta rocks.
820-840'	Cgl, as abv, 50%; Sd, as at 710', 50% (Cgl becomes finer gr at 840')
850'	Cgl, as abv, 30%; Sd, f-m, ang-rdd, p. srtd, 70%
860-880'	Cgl, as abv, 80%; Sd, as abv, 20%
890-1000'	No samples.
1010'	Cgl, as abv, 40%; Sd, f-m, sbang-sbrd, (looks good for water) 60%
1020-1040'	Sd, crs-v crs, sbrd-w rdd, 70%-30%, Cgl, 2-4mm, vol., 30%-70%
1050'	Sd, f-m w/s v crs; sbang - rdd, Labradorite gr. (good water?)
1060' fm change	Cgl, 2-5mm, w rdd peb, some frag crsr matl; Mnr sd, as abv. fm change.
1070'	Cgl, as at 1010', 30%; Rhyolite, lt gry, qtz pheno crysts, frag labradorite, 70%
1080-1090'	Rhyolite, as abv, 20%; Sd, f-m, ang-subrd, poss good water, 80%.
1100'	Cgl, as at 1010', 40%; Rhyolite, as at 1070, 60%
1110'	Cgl, as at 1010', 20%; Rhyolite, as at 1070, 50%; sd, crs, ang-subrd, 30%; Mnr Ss, wht, f, w rdd, prob. cavings.
1120'-1150'	Rhyolite, as at 1070, 20%-50%; Sd, as at 1080', 50%-80%. Ss, brn f-m, slty, w rdd, at 1130' 10%.

Drilled with rotary rig. Samples from return pipe. Depths from top of rig floor 5 ft. above ground surface. Drilled to 455', cased and completed in spring 1965. Drilled from 455' to total depths of 1010' and E-logged in August 1965.

9/2/65 Tucson Meeting

Gilberts Office

14" bowls are to be used in both wells

Week of Sept 17

Sec 32 Well

1. Run 14" bowls on 10" column to 500'. Run 1½" black pipe at same time so ~~the~~ it extends past bowls. Bend small pipe to column

2 Pump till clean plus one hour

~~3. Use flowmeter~~

3. Let well sit three hours at least - keep track of recoveries to be sure recovery is reasonably complete in that time

4. Run flowmeter at 1200, 1700, 2200 and maximum drawdown steps. If changes in test equipment make these steps impractical to achieve, another set will

5. Take water level volume measurements and vol at the following times after increases in pumping rates:

30 sec.	~~1100 RPM~~ ~~1200 - 250~~
40 sec	~~1400 - 300~~
1 min	1600 - 350
1½ min	1800 -
2 min	
3 min	
5 min	
10 min	
every 5 min afterwards	

Length of steps times will depend on ~~for~~ requirements of flow velocity tests. An effort should be made to keep steps equal in length. ~~EF~~

be figured out by consultation between pump operators and Dick Davis. It may be necessary to maintain ~~pump~~ a constant RPM on the motor during each step at some sacrifice of the desired constant volume.

Sec 28

1. Run 14" bowls on 10" column to ~~357~~ 357'
with 1½" pipe as for Sec 32 wells, putting
bend below bowls & guide VSGS 4 mounts
into 12¾" casing.
2. ~~Run same~~ Clean up well by
pumping.
3. Run new step down tests as on Sec 32
well.

a conclusion as to where we should drill wells in Section 32 and 29 very shortly. Do you have any recommendations as to whether it would be best to use a rotary rig or a cable tool rig for drilling in this area? May we hear from you very soon.

Very truly yours,

K. W. Richardson

cc: Al Erickson

Enclosures

P. S. We are also enclosing the log for well #22, and a well report written by our engineer Gene Anderson re: wells 16-17--18-19.

1184

Willcox Pump & Equipment Co.

522 N. Haskell Ave.
Willcox, Arizona

December 11, 1963

OTHO JOHNSON,
Owner

PHONE 384-2287
P. O. Box 907

WELL LOG

SUNIZONA WELL # 22

Lot 20 Block 75
Unit No. 5

0 -	70'	Conglomerate with Red Clay
70' -	80'	Red Sand
80' -	110'	Sand & Clay
110' -	135'	Clay
135' -	140'	Rock Ledge
140' -	165'	Sand & gravel w/clay streaks, water
165' -	169'	Hard Rock
169' -	175'	Sandy clay with some gravel
175' -	182'	Hard Rock

Water @

Static Water Level - 116'-7"

Well Test - 82 gpm @ 118'-4"

623 6316

Willcox Pump & Equipment Co.

522 N. Haskell Ave.
Willcox, Arizona

OTHO JOHNSON,
Owner

PHONE 384-2287
P. O. Box 907

SUNIZONA WELL # 23 BEARCAT RD.

WELL LOG

Unit 1

0 - 10'	-	Sand
10 - 45	-	Sand, clay, small gravel
45 - 67	-	Sandy clay
67 - 88	-	" " W/gravel
88 - 100	-	Hard Packed Sandy Clay
100 - 108	-	Gravel
108 - 135	-	Brown Sand & Clay W/fine gravel
135 - 155	-	Reddish brown clay & sand
155 - 158	-	Gravel - 1st water
158 - 185	-	Reddish brown clay & sand W/gravel streaks
185 - 192	-	Gravel - Water
192 - 255	-	Gravel streaks in Brown red clay - Water

8" Casing set 125'-4"
6" Casing set 112' to 255 ft
Perforations 180' - 250' (3 rows-1 cut/ft.-12" length)
Static Water Level 137 ft.

Well Test: 48 gpm @ 146 ft.
65 gpm @ 148 ft.
85 gmp @ 149½ ft.

Willcox Pump & Equipment Co.

522 N. Haskell Ave.
Willcox, Arizona

OTHO JOHNSON,
Owner

PHONE 384-2287
P. O. Box 907

25
SUNIZONA #1 CHIRICAHUA ROAD

WELL LOG

0 - 5	Top Soil
5 - 27	Heavy gravel, light clay
27 - 30	Clay
30 - 55	Clay, gravel, brown red sand
55 - 65	Hard sandy clay
65 - 75	Clay & gravel
75 - 90	Hard sandy & clay
90 - 105	Clay with streaks of small gravel
105 - 120	Clay, sand & gravel
120 - 125	Large gravel & clay, hard
125 - 170	Clay, fine gravel sand, medium hard
170 - 175	Clay & pea gravel (water)
175 - 215	Clay with heavy gravel
215 - 252	Hard, gravel & clay

6" Casing set to 252 ft.
Perforations: 165-250 ft. (3 rows - 1 cut per foot-3/16x8")

Static Water level:	146 ft.
Well Completed	Jan. 21, 1964
Well Test	Jan. 22, 1964
429 gpm	@ 150
50 gpm	@ 152
81 gpm	@ 156

WILLCOX PUMP & EQUIPMENT CO.

Otho Johnson

A. D. Chrobak

Well Log

SW cnr
Sec 7
T. 18E
R 27S

Lot No. 218, Unit 2

0 - 8	feet	Sandy Top Soil
8 - 56	"	Sandy clay
56 - 85	"	Clay
85 - 123	"	Sandy clay
123 - 126	"	Sand & Gravel (water)
126 - 145	"	Sandy clay
145 - 148	"	Sand & Gravel (Water)
148 - 173	"	Sandy clay
173 - 177	"	Sand & Gravel (Water)
177 - 185	"	Clay

Static Water level 112 feet

Cased with
186 feet 5½" O.D. Casing

Drilled July 1962

Red Davison
Well Log

SE¼, NW¼
SE¼, Sec 8
T 18 S
R 27 E

Lot No W. ½ 30 Unit 1

0 - 6 feet	Sandy top soil	
6 - 60 "	Gravely clay	
60 - 80 "	clay	
80 - 142 "	Sandy clay	
142 - 145 "	Gravel	(Water)
145 - 164 "	Sandy clay	
164 - 168 "	Gravel	(Water)
168 - 183 "	Sandy clay	
183 - 188 "	Gravel	(Water)
188 - 200 "	Gravely clay	

Static water level 138 feet

1½ H.P. Submersible Pump Setting 168 ft

Cased with
201 feet 8" casing

Drilled July 1962

RUSSELL LEWIS

200' SW of ctr of NE¼, SE¼

Sec 7
T18S
R27E

Well Log

Lot No E ½ 159 Unit 2

0 - 10	feet top soil	
10 - 65	" Sandy Clay	
65 - 85	" Clay	
85 - 121	" Sandy Clay	
121 - 123	" Sand	(Water)
123 - 143	" Sandy Clay	
143 - 147	" Sand & Gravel	(Water)
147 - 172	" Sandy Clay	
172 - 176	" Gravel	(Water)
172 - 184	" Sandy Clay	

Static Water level 114 feet

¾ H.P. Submersible Pump Setting 148 ft.

Cased With
185 feet 5½" Casing.

Drilled Aug. 1962

Jonan Van Waginigan

Well Log

NW cnr, NW¼, SW¼ Sec 7, T 18S R 27E

Lot No. W. ½ 152 Unit 2

0 - 3	feet	to soil
3 - 70	"	Clay
70 - 112	"	Sandy clay
112 - 115	"	Sand & Gravel (Water)
115 - 138	"	Sandy Clay
138 - 141	"	Sand & Course Gravel (Water)
141 - 163	"	Sandy clay
163 - 165	"	Gravel (Water)
165 - 177	"	Clay
177 - 180	"	Sand & Gravel (Water)
180 - 184	"	Clay

Static Water level 108 feet

¾ H.P. Submersible Pump Setting 168 ft.

Cased with
185 ft 6" Casing. Drilled Aug. 1962

DONALD FOULK
Well Log

SW¼, NW¼, NW¼
Sec 8
T 18 S
R 27 E

Lot No. 57 Unit 1

0 - 7 feet	Top Soil	
7 - 70 "	Sandy Clay	
70 - 78 "	Clay	
78 - 123 "	Sandy clay	
123 - 127 "	Sand & Gravel	(Water)
127 - 155 "	Sandy clay	
155 - 160 "	Sand & Gravel -	(Water)
160 - 180 "	Clay	
180 185 "	Gravel	Water
185 - 199 "	Gravly Clay	

Static water level 116 feet

1½ H.P. Submersible Pump Setting 168 ft

Cased With
200 feet 8" casing

Drilled Sept 1942

Mrs BURRELL
Well Log

ch.
SE¼, SE¼

Sec 12
T18S
R26E

Lot No. 6 Block 4 Unit 3

0 - 6 feet	Top Soil	
6 - 9 "	Conglomerate	
9 - 56 "	Sandy Clay	
56 - 66 "	Clay	
66 - 117 "	Sandy Clay	
117 - 121 "	Sand & Gravel	(Water)
121 - 136 "	Sandy Clay	
136 - 139 "	Sand & Gravel	Water
139 - 156 "	Sandy Clay	
156 - 160 "	Sand & Gravel	(Water)
160 - 176 "	Clay	
176 - 178 "	Gravel	
178 - 185 "	Clay	

Static Water level 108

¾ H.P. Submersible Pump Setting 168 ft.
Cased With
186 feet 6" Casing. Drilled Sept. 1962

Mc Coy

close to #13

Well Log

Lot No 29 Block 13 Unit 3

0 - 3 feet	top soil	
3 - 20 "	Tight Gravely clay	
20 - 115 "	Sandy clay	
115 - 120 "	Sand & Gravel	(Water)
120 - 138 "	Sandy clay	
138 - 141 "	Sand & Gravel	(Water)
141 - 156 "	Sandy clay	
156 160 "	Sand & Gravel	(Water)
160 - 176 "	Sandy clay	
176 - 179 "	Sand & Gravel	Water
179 - 185 "	Soft clay	

Static Water Level 106 feet

~~3/4~~ H.P. Submersible Pump setting 168 ft.

Cased With
184 feet 6" casing.

Drilled Nov. 1962

HARVEY KOHL
Well Log

Ctr Sec 12
T 18S
R 26E

Lot No. 2 Block 7 Unit 3

0 - 5 feet	top soil	
5 - 20 "	light & sandy clay	
20 - 112 "	Sandy clay	
112 - 115 "	Sand & Gravel	(Water)
115 - 130 "	Sandy clay	
130 - 135 "	Gravel	(water)
135 - 156 "	clay	
156 - 160 "	Sand & Gravel	(Water)
160 - 172 "	Gravely clay	
172 - 175 "	Gravel	
175 - 181 "	clay	

Static Water level 102 feet

3/4 H.P. Submersible Pump setting 168 ft.

Cased with
182 feet 6" Casing

Well Drilled Dec. 1962

WILLIAM MYNOTT
Well Log

NW¼, SE¼, NE¼
Sec 12
T 18S
R 26W

Lot No. 13 Block 14 Unit 3

0- 3 feet	top soil
3 - 28 "	tight Gravely clay
28 - 111 "	Sandy clay
111 - 115 "	Sand & Gravel (water)
115 - 135 "	Sandy Clay
135 - 140 "	Course Sand & Gravel (water)
140 - 162 "	Sandy clay
162 - 168 "	Sand & Gravel (water)
168 - 183 "	clay

Static Water Level 98 feet

¾ H.P. Submersible Pump Setting 168 ft.

Cased With
184 feet 6" Casing

Drilled Dec. 1962

ROBERT N. EWING
Well Log

ctr
SE¼, SE¼
Sec 12
T 18S
R 26E

Lot No. 5 Block 4 Unit 3

0 - 7	feet	top soil	
7 - 11	"	Conglomerate	
11 - 117	"	Sandy Clay	
117 - 121	"	Sand & Gravel	(water)
121 - 142	"	Sandy clay	
142 - 147	"	Sand & Gravel	(water)
147 - 166	"	Clay	
166 - 170	"	Sand & Gravel	water
170 - 180	"	Gravely Clay	

Static Water level 110 feet

¾ H.P. Submersible Pump Setting 168 ft.

Cased with
181 feet 6" Casing

Drilled Jan 1963

Paul Hodnette
Well Log

close to #13

Lot No 8 Block 13 Unit 3

0 – 5 feet	top soil	
5 – 16 "	tight gravely clay	
16 – 116 "	Sandy clay	
116 – 120 "	Sand & Gravel	Water
120 – 138 "	Sandy clay	
138 – 144 "	Sand & Gravel	Water
144 – 159 "	Sandy clay	
159 – 162 "	Sand & Gravel	Water
162 – 181 "	Gravely clay	

1½ H.P. Submersible Pump setting 168 ft.

Cased with
182 feet 8" casing

Drilled Jan. 1963

MYRON INGLE
Pearce, Arizona

WELL LOG

SUNIZONA

Mr. Cusick

NW cor Sec 12 T 18S R 26E

Lot 27, Block 16, Sunizona # 3

Dale

I---------4 top soil

4--------I8 sandy clay

I8-------80 soft sandy clay

80-------90 gravel (seep)

90------II5 sandy clay

II5-----I20 fine sand (water)

I20-----I75 red sandy clay

I75-----I80 sand, gravel, (water)

I80-----I84 clay

I84 ft. &in. of 5/I6" used 8" pipe.

WELL LOG

SUNIZONA

NW cor
NE¼, NW¼, NW¼
Sec 12, T 18S, R 2E

Mr. Jack Gilbert Lot 21, Block 16
Sunizona Unit #3

I----------I2 sandy

I2----------50 clay

50----------65 gravel

65----------85 clay

85----------90 fine sand (water seep)

90----------I20 sandy clay

I20---------I30 fine sand (water poor)

I30---------I60 clay

I60---------I62 small gravel (water fair)

I62---------I76 sandy clay

I76---------I83 sand & gravel (water good)

I83---------I92-5" clay

I92 ft. 5 in. 5/I6" wall of 8 in. pipe

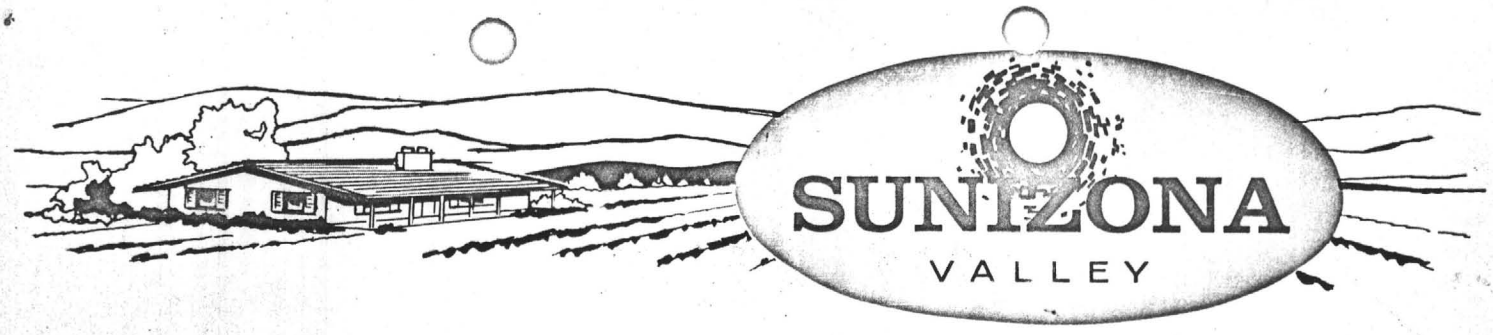
SUNIZONA, P.O. BOX 1010, WILLCOX, ARIZONA

WELL LOG **LOT 195 UNIT 2**
MORRIS WELL **DRILLED BY LEO COOK**

Surface Soil	16 feet
Clay and Gravel	112 feet
Sand, Water, Gravel	3 feet
Clay Gravel	25 feet
Sand, Water, Gravel	8 feet
Clay and Gravel	16 feet
Sand, Water, Gravel	2 feet
First Water	128 feet
Second Water	156 feet
Third Water	180 feet
Total Depth	182 feet
Water Level	117 feet

16 feet of 8 inch casing at surface

SW ¼, SE ¼, SW ¼
Sec 7, T18S, R27E



SUNIZONA, P.O. BOX 1010, WILLCOX, ARIZONA

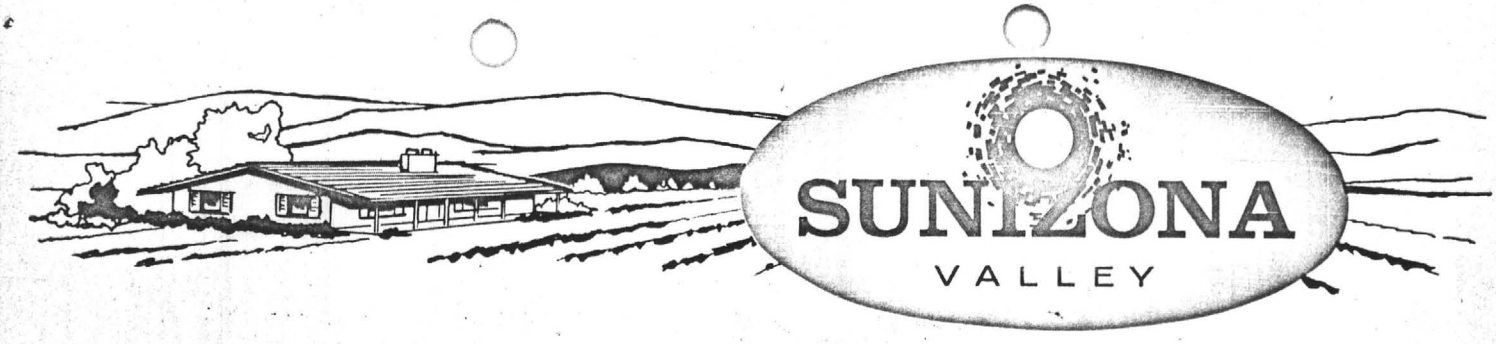
WELL LOG **LOT 213 UNIT 2**

RAYMOND LEROY WELL **DRILLED BY LEO COOK**

Surface Soil	16 feet
Clay and Gravel	40 feet
Caliche	8 feet
Clay	58 feet
Sand, Gravel, Water	2 feet
Clay	24 feet
Sand, Water, Gravel	8 feet
Clay	4 feet
First Water	122 feet
Second Water	148 feet
Total Depth	160 feet
Water Level	119 feet

No Casing

close to Morris Well



SUNIZONA, P.O. BOX 1010, WILLCOX, ARIZONA

WELL LOG **LOT 161W UNIT 2**

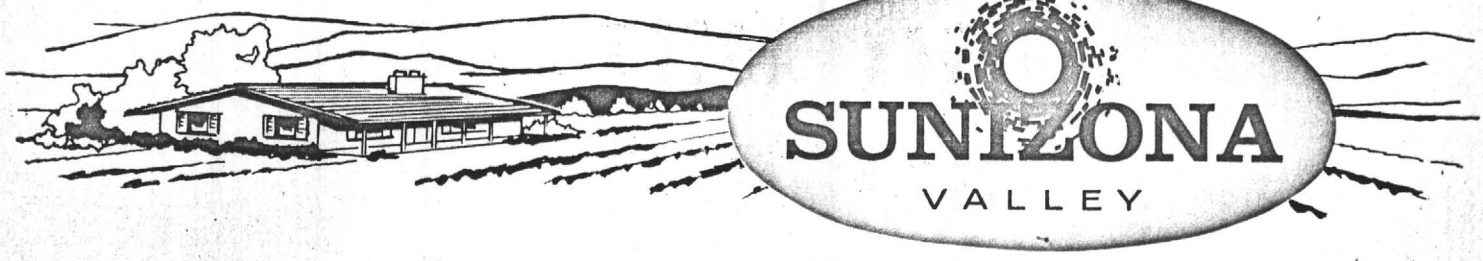
EVERETT S. BAKER WELL **DRILLED BY LEO COOK**

Surface Soil	12 feet
Clay and Gravel	101 feet
Sand, Water, Gravel	3 feet
Clay and Gravel	24 feet
Sand, Water, Gravel	6 feet
Clay	38 feet
Sand, Water, Gravel	10 feet
Clay and Gravel	6 feet
First Water	113 feet
Second Water	140 feet
Third Water	184 feet
Water Level	111 feet

200 feet 6 inch casing

60 feet of Perforation (with torch)

NW cnr
SW¼, SW¼, Sec 7
T18S, R27E



SUNIZONA, P.O. BOX 1010, WILLCOX, ARIZONA

WELL LOG **LOT 135 UNIT # 2**

LEO L. COOK WELL **DRILLED BY LEO COOK**

Surface Soil	15 feet
Clay and Gravel	35 feet
Caliche	10 feet
Clay and Gravel	53 feet
Sand, and Water Gravel	3 feet
Clay	24 feet
Sand, Gravel	10 feet
Clay and Gravel	6 feet
First Water	113 feet
Second Water	140 feet
Total Depth	156 feet
Water Level	111 feet

No Casing

N E¼, SW¼, NW¼
Sec 7, T 18 S, R 27 E

#3

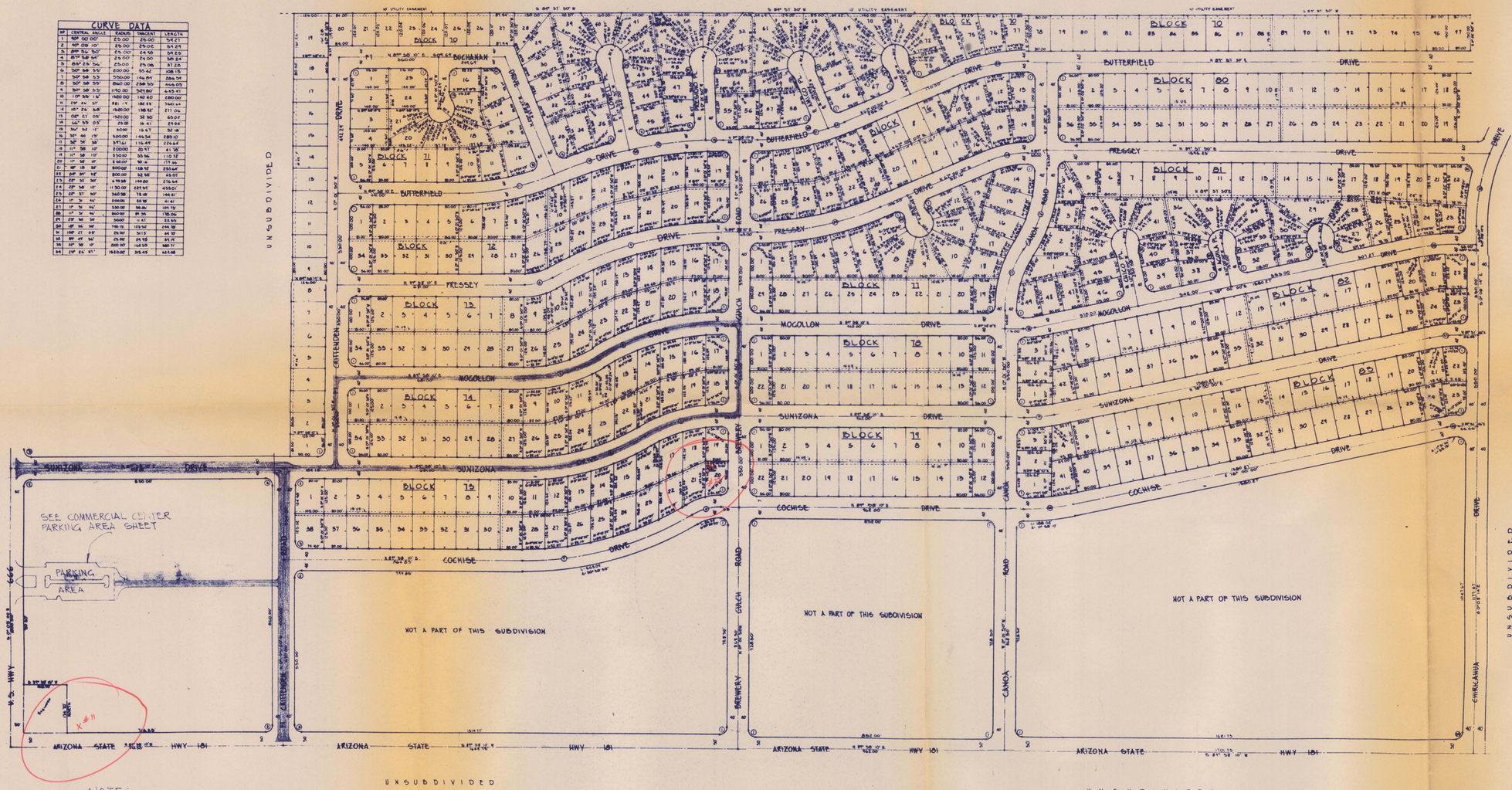
UNSUBDIVIDED

UNSUBDIVIDED

UNSUBDIVIDED

UNSUBDIVIDED

CURVE DATA				
BP	CENTRAL ANGLE	RADIUS	TANGENT	LENGTH
1	90° 00' 00"	25.00	25.00	39.27
2	90° 09' 10"	25.00	25.02	39.34
3	89° 54' 50"	25.00	24.98	39.26
4	90° 00' 00"	25.00	25.00	39.27
5	89° 29' 54"	25.00	25.06	39.06
6	30° 58' 33"	200.00	55.42	108.15
7	30° 58' 33"	300.00	142.84	286.34
8	30° 58' 33"	860.00	296.50	446.05
9	30° 58' 33"	1720.00	593.80	643.61
10	1° 09' 18"	1620.00	162.60	680.00
11	19° 24' 37"	861.19	180.88	340.44
12	49° 26' 58"	1520.00	186.56	211.04
13	06° 21' 05"	1520.00	32.30	65.07
14	46° 33' 03"	25.00	19.41	21.84
15	34° 42' 12"	50.00	15.63	32.18
16	32° 40' 15"	500.00	146.54	285.10
17	32° 34' 30"	371.61	116.49	226.64
18	111° 38' 10"	200.00	20.53	41.18
19	111° 38' 10"	350.00	35.96	110.72
20	17° 38' 48"	1460.00	90.16	179.96
21	89° 18' 38"	800.00	1128.92	250.64
22	89° 30' 42"	800.00	32.58	66.01
23	89° 30' 30"	6780.88	1449.20	2716.64
24	89° 34' 10"	11 50.00	2491.54	4550.01
25	89° 57' 30"	360.88	78.68	144.41
26	17° 34' 44"	260.80	80.58	41.41
27	17° 34' 44"	350.80	56.84	189.78
28	17° 34' 44"	860.80	89.36	130.06
29	89° 46' 36"	360.80	1.41	88.55
30	18° 44' 48"	140.15	103.54	244.18
31	180° 21' 09"	25.00	36.13	44.18
32	89° 21' 40"	25.00	24.95	39.71
33	89° 38' 18"	800.00	148.59	1481.71
34	179° 24' 51"	18600.07	345.49	623.08



NOTE:

PAVING WILL COVER SUNIZONA DRIVE E. TO BREWERY GULCH ROAD, THENCE N. TO MOGOLLON DRIVE, THENCE W. TO CRITTENDEN DRIVE, THENCE S. TO SUNIZONA DRIVE. THIS PAVING WILL BE 30 WIDE, EXCEPT SUNIZONA DRIVE TO INTERSECTION OF FT. CRITTENDEN ROAD S. TO ARIZONA STATE HWY 181 WHICH IS 40' WIDE. A 20' STRIP WILL BE CONNECTED FROM PARKING AREA TO FT. CRITTENDEN DRIVE.

#19

#18

APPROVALS

I, JEAN B. PLACE, CLERK OF THE BOARD OF SUPERVISORS HEREBY CERTIFY THAT THIS PLAT WAS APPROVED BY THE BOARD OF SUPERVISORS OF COCHISE COUNTY, ARIZONA, ON THIS _____ DAY OF _____, A.

CLERK, BOARD OF SUPERVISORS — DATE

CERTIFICATION OF SURVEY

THIS IS TO CERTIFY THAT THIS PLAT CONSISTS A SURVEY COMPLETED UNDER MY SUPERVISION. [illegible]

GENE E. ANDERSON

COUNTY RECORDER

State of Arizona }
County of Cochise } ss

THIS PLAT WAS FILED AND RECORDED AT THE REQUEST OF _____ ON THIS _____ DAY OF _____, A.D. _____ AT _____ M. IN BOOK _____ OF MAPS & PLATS AT PAGE _____ THEREIN

AMOS O. DYER
COUNTY RECORDER
COCHISE, COUNTY

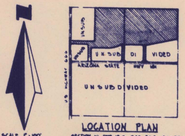
By _____
DEPUTY

#17

GENERAL NOTES

- ○ INDICATES A ½" STEEL PIN, SET FLUSH, UNLESS NOTED
- (R) INDICATES A RADIAL LINE
- ⊕ INDICATES A CURVE NUMBER, SEE CURVE TABLE
- 7.5' 7.5' / 5.16 5.16 INDICATES A 15' UTILITY EASEMENT, 7.5' ON EACH SIDE OF PROPERTY LINE

#16



LOCATION PLAN
SECTION 10 TWP 23 S. RGE 26 E. G & S.R.B. & M.
COCHISE COUNTY, ARIZONA
SCALE 1" = 1 MILE

DEDICATION

WE, THE UNDERSIGNED HEREBY WARRANT THAT WE ARE ALL AND THE ONLY PARTIES HAVING ANY RECORD TITLE INTEREST IN THE LAND SHOWN ON THIS PLAT AND WE CONSENT TO THE SUBDIVISION OF SAID LAND IN THE MANNER SHOWN ON THIS PLAT. WE HEREBY DEDICATE TO THE USE OF THE PUBLIC ALL RIGHTS OF WAY SHOWN HEREON, INCLUDING ALL STREETS, ACCESS AND UTILITY EASEMENTS, TOGETHER WITH AN ADDITIONAL FIVE (5) FOOT AERIAL OR OVERHEAD EASEMENT ON EACH SIDE OF ALL UTILITY EASEMENTS FOR OVERHEAD WIRES, CROSSBANKS, ETC. ON UTILITY POLES. UTILITY EASEMENTS AS SHOWN HEREON ARE HEREBY DEDICATED FOR THE PURPOSE OF INSTALLATION AND MAINTENANCE OF PUBLIC UTILITIES, INCLUDING WIRES.

WILLEN CORPORATION, A California Corporation, As Owner

By _____
E.E. ECKHARDT, Its President

ATTEST: _____
L.M. PRICE, Secretary

State of California
County of San Mateo } ss

On this the 27 day of January, 1967, before me Barbara A. Bridge the undersigned officer, personally appeared E. E. Eckhardt and L.M. Price who acknowledged themselves respectively to be President and Secretary of the Willen Corporation, a corporation, and that they as such President and Secretary being authorized so to do, executed the foregoing instrument for the purposes therein contained, by signing the name of the corporation by themselves as President and Secretary.

In witness whereof I hereunto set my hand and official seal.

Barbara A. Bridge
NOTARY PUBLIC

My commission expires June 16, 1967

SUNIZONA ACRES UNIT №5

BEING A SUBDIVISION OF A PORTION OF THE W½ OF SECTION 10, TWP 23S., RGE 26 E., G & S.R.B. & M., COCHISE COUNTY, ARIZONA

GENE E. ANDERSON
REGISTERED CIVIL ENGINEER №2565
REGISTERED LAND SURVEYOR №10187
1110 SOUTH TUCSON BOULEVARD
TUCSON, ARIZONA

SHEET 1 OF 6 — OCTOBER 1966 — JOB №1804-06

List of Symbols used in Sample Descriptions
(After A.A.P.G.)

SYMBOL	MEANING
abv	above
ang	angular
ark	arkosic
bent	bentonite
brn	brown
cal	caliche
calc	calcareous
cgl	conglomerate
cly	clay
crs	coarse
f	fine grained
fm	formation (geologic rock unit)
frag	fragment (s)
gr	grain
gry	gray
m	medium grained
matl	material
meta	metamorphic
mm	millimeter
mnr	minor
p	poor,poorly
peb	pebbles
por	porosity
pt	part
qtz	quartz
qtzt	quartzite
rd,rdd	round,rounded
s	some
sd	sand (loose grains)
sl	slight
slt,slty	silt,silty
srtd,srtg	sorted, sorting
ss	sandstone (indurated)
subang	subangular
subrd	subrounded
swells	swells when water is added
v	very
vol	volcanic
w	well
w/	with
w/o	without
wh	white

HEINRICHS GEOEXPLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623-0578

Sample description from Willen Well
NE 1/4, NE 1/4, Sec. 32, T17S, R27E

August 11, 1965

10' Sd, f - crs, ark, slty
20' Cly, brn, slty, 20% cgl.
30' As above, w/50% cgl.
40' Cly, as above.
50' Crs sd - cgl, p. srtd, ang. vol . peb., ark.
60' As above, 40%; cly, slty, brn, swells, 60%
70' " "
80' Sd, f, slty, sbrd, v.cly, calc, ark.
90' Sd, as abv. except f - m gr.
100' as abv. except f-crs gr.
110' Sd, f-v crs, sbrd-w.rd, ark.
120' Sd, crs, subrd-w.rd, ark 70%; Sd,f,slty, 30%
130' Sd, f-v.crs, sbrd, 70%. Cgl, 3mm, ang, volc. 30%
140' Sd, m-crs, ang w/s cryst qtz, ark., s cgl peb.(Fair aquifer).
150' Sd, as above, 50%; cgl, 2-3mm, vol. ped. ang.
160' Sd, as at 140'
170' - 190- As above with more v crs. matl.
Fm change
200' Sd, v crs, ang, ark w/volc. peb.
210' Sd, f-crs, ang, ark, 70%; Cgl, 3mm, ang, vol. peb., 30%
220' - 240' Cgl, 2-4mm, ang, vol , & meta peb.
250' - 300' Cgl, 3-5mm, ang-sbrd, vol. peb. wh qtzt, meta. peb.
(poss. good aquifer)
310' As above w/ Sd, F-crs., ang-sbrd, ark, 50%, calc.
320' - Cgl, 2mm-10mm, w rdd peb, vol. peb-mostly rhyolite,
(good aquifer)
330' - Cgl, 2-5mm, sbrd-w.rd, vol. peb., meta peb, 50%; Sd,
f-m, ang, slty & cly in pt, 50%, calc.
340' - Cgl, as above 70%; Sd, as ab. 30%.
350' - Sd, m-v crs, ang, ark., many qtz frag., ark, calc;
some Cgl, as in 340'.
360' - As abv; Sd, 50%; Cgl, 50%
370' - Cgl, as abv. 30%; Cly, sd & slt., 70%, calc.
380 - 400 - Cgl, as above 50%; Cly, sd & slt 50% calc.
410' - 420'- Cgl, as above w/ some caliche coating & Cu stain,
70%; Cly, sd & slt, as abv. 30%
430' - Cgl, 2-5mm, sbrd, some cal. coating; vol. peb.
440' - as above
450' Cgl, 5 - 10 mm, ang-sbrd, vol. peb., 20% Cgl, 2mm, ang-sbrd,
60%, Cly, brn, sdy, 20%, calc.
460' - 500' Cgl, 2-3mm, sbrd, vol & meta peb.
510' - Cgl, as above - 50%; sd, v crs, ark, ang, 40%; cly 10%
520' - 550' - Cgl, as at 460'
560' - Cgl, as abv w/some sdy cly.
570' - 580' - Cgl as at 460'
590' - Sd, v crs, ang, & cgl, 2-3mm, ang, ark., 40%. Cly, brn,
calc, 60%.
600' - 700'- Cgl, more than 4mm, sb ang-ang, vol, meta & qtzt
frag, 30%; Sd, m-v crs, ang-subrd, ark, 70%
Poss well cemented.

(more)

710' - as above w/ some clay (less than 10%)
720' - as above w/o clay
730' - as above w/ some clay, brn.
740' - Cgl, as abv, 30%; cly as abv, 70%
750' 760' - as above
770' - Sd, m-v crs, w rdd-sb ang, ark.
780' - Sd, m-crs, rdd-ang, ark, fr. sttg, (good aquifer)
790' - 810' As above w/some f gr sd (poss tight)
820' - Cgl as at 460'
830' - Sd as at 790'
840' - Cgl, 2-3mm, rdd-ang, vol, meta & qtzt peb, 70%; sd, f-crs, ang-sbrdd, cly, slty, 30%
850' - 870' - Cgl as at 460'
880' - As above, 60%; cly, brn, slty, 40%
890' - Sd, m-v crs, ang-sbrdd, ark, (Looks hard on bits)
900' - Sd, M-v crs, ang - sub ang, ark, frag of gry qtzt sd, (looks hard)
910-960' - as above
970' - Sd, f-crs, ang, ark
980' - as above
990' - Sd as at 900' w/pyrite
1000' - Cgl, less than 3mm, ang, vol. frag., 20%
Sd, m w/mnr crs, Sb ang - w rdd, ark, 80%
1010' as above w/mnr cly.
1020' - Sd, mstly f w/m & mnr crs, ang, ark, p. por (?)
1030' - Sd, as abv; v mnr bent.
1040'- Sd, f-vf, subang, sl ark, m sttg, 80%. Sd, v crs, subang, frag vol, meta, 20%
1050' - Cgl & v crs sds, ang, frag. andesite porphyry, meta, qtzt.
1060' - Sd, m-crs, subang - sbrdt, ark, m sttg, w/mnr cgl.
1070' - Sd, as abv, w/s v crs frag meta, vol, qtzt; one ball graphite, prob from rig.
1080' - 1090' - Sd, v crs & cgl, less than 3mm, frag, vol, meta, qtzt., all sbang-sbrdd, prob. good por.
1100' - Sd & cgl, as abv, 70%; sd, f-m, w rdd - sbang, ark, 30%
1110' - no sample
1120' - Sd, m- v crs, cgl, rdd-ang, ark, p. srtd.
1130' - 1140' - Sd, f-m, sbang- w rdd, ark, f por
1150' - Sd, crs, ang, ark, frag vol, meta, qtzt.
1160' - 1170' - Sd, as at 1120' - 1130'

Drilled with rotary rig.
Samples from return pipe.
Depths from top of rig floor 5 ft. above ground surface.
Drilled to 1010' and E-logged on August 5, 1965
Back in hole and drilled to T.D. at 1170 ft. on August 7, 1965.

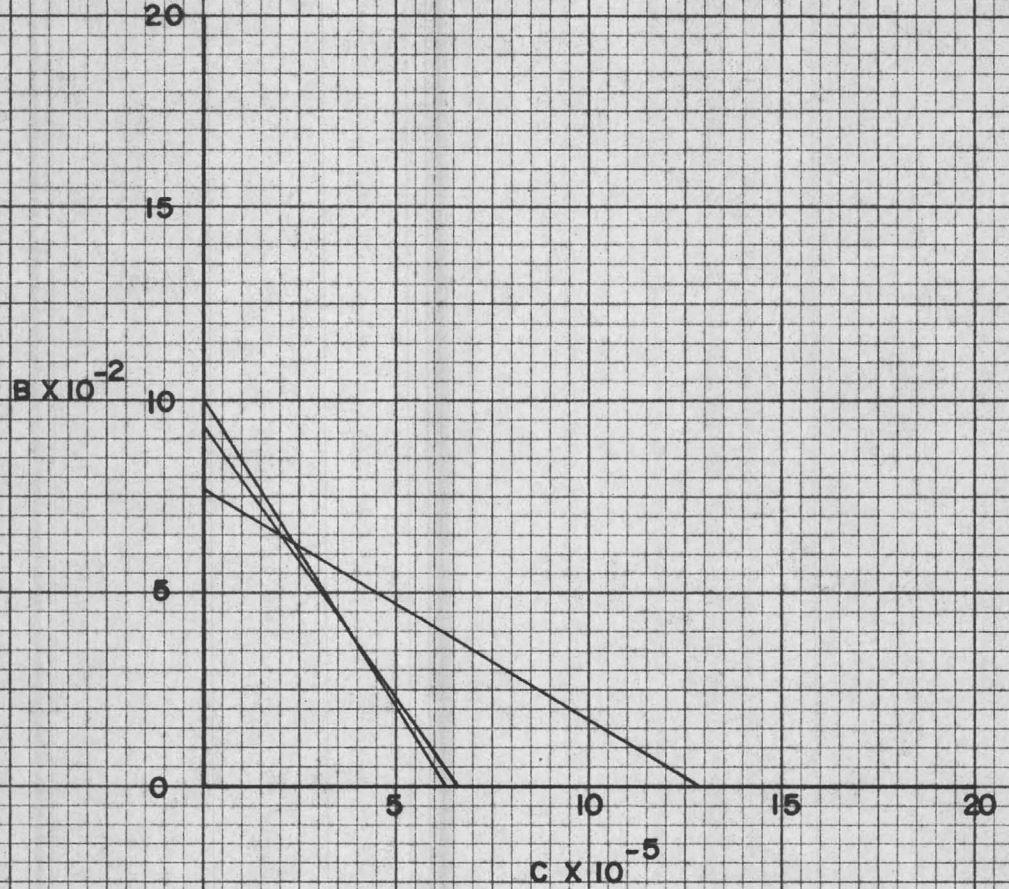


FIG. 1

HEINRICHS GEOEXPLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623-0578

GRAPHICAL SOLUTION OF FLOW LOSS COEFFICIENTS. IDEAL SPECIFIC CAPACITY EQUALS RECIPROCAL OF B

FOR
WILLEN CORP.
AUGUST 1965

K&E 10 X 10 TO THE INCH 359-5DG KEUFFEL & ESSER CO. MADE IN U.S.A.

DEVELOPMENT OF WILLEN WELL
NE ¼, NE ¼, SECTION 32
T 17 S, R 27 E

For

Willen Corporation

August 1965

by

Heinrichs Geoexploration Company
P. O. Box 5671 Tucson, Arizona

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MAP POCKET:

STEP DRAWDOWN TESTS

DEVELOPMENT OF WILLEN WELL

For Willen Corporation August 1965

INTRODUCTION

Heinrichs Geoexploration Company was requested to outline the procedures for developing a well drilled at Sunizona Acres in the NE ¼, NE ¼, Section 32, T 17 S, R 27 E. These procedures were carried out by Gilbert Pump of Tucson, Inc., Tucson, Arizona.

Testing was started about August 20, 1965 by Gilbert. On August 23, 1965, R. W. Davis of Geoex went to Sunizona to observe a step drawdown test. Some minor development work was done also to see if yields could be increased. Development and testing were halted on August 24, 1965. The test records were analyzed by R. W. Davis.

SUMMARY AND CONCLUSIONS

The well appears to be capable of producing at least one and a half times what it is now. Present specific capacity is about 10.5 gallons per foot of drawdown. The main deterrent to good production is probably drilling mudcake and/or bentonite.

Three methods of further development are offered for consideration:

1. If the well could be pumped down to 400 or 500 feet, some of the mud might come loose.

2. Water could be pumped under high pressure into a zone between two packers and forced at high velocity into the gravel pack. The jetting action might break up any drilling mudcake.

3. Compressed air might be used to set up a more efficient surging action.

4. Pumping from opposite the deeper aquifers would be beneficial.

Before proceeding with more development, however, the results of developing another well should be evaluated. It is understood that another is planned in this section. If that well is completed as the present one, and then developed by somewhat different techniques, the relative worth of the two methods could be evaluated. Also, if tests show that further development would not eliminate

the need for a third or fourth well, this would have a bearing on the final decision.

PROCEDURE

Gilbert Pump was instructed to develop the well according to their standard procedures. When they felt that it was sufficiently developed, a step drawdown test was run. Gilbert pumped the well for ten hours. After approximately nine hours, the well cleared. Gilbert personnel did not feel that surging or other development would improve yields.

A step drawdown test is a fairly common method of evaluating the efficiency of a well. In order to obtain reliable results, at least three steps are ordinarily demanded. Only two definitive steps were obtained in this test, although three attempts were made to get more. However, enough information was gained to reach some conclusions. A chart of the step drawdown tests is included with this report.

During the course of the test, five hours were used to alternately pump and surge the well. A pumping rate of 2200 gpm was maintained for as much as thirty minutes at a time. The surge cycle was about 50-60 seconds in period. The well was pumped until water reached the surface, usually about ten seconds, and then the water was allowed to drain back. This produced a strong inwash, but a rather weak backwash. The surging action did produce some sand and is believed to have increased the specific capacity about 10% although this is hard to evaluate positively.

CALCULATIONS

A method devised by Jacob for the U. S. Geological Survey from empirical data gives the most conservative estimate of flow losses:

$$s = BQ + CQ^2$$

where s = residual drawdown
Q = pumping rate (gpm)
B = laminar flow loss factor
C = turbulent flow loss factor

Taking data from the test begun on August 23 at 10:00 and using drawdowns at 20 minutes after start of each step:

Step	Formula	At C=0	At B=0
1	$43=740B + (350X10^{3})C$	$B=7.81X10^{-2}$	$C=12.8X10^{-5}$
2	$137=1450B + (210X10^{4})C$	$B=9.45X10^{-2}$	$C=6.5X10^{-5}$
3	$161=1600B + (256X10^{4})C$	$B=10.1X\ 10^{-2}$	$C=6.29X10^{-5}$

Step three was not large enough to be definitive. A faulty pump motor prevented adequate drawdown from being achieved.

Figure I is a graph of the three equations. At the best intersection of the lines, ($B=6.2X10^{-2}$), the reciprocal of B is the ideal specific capacity of the well. That is, it indicates the maximum specific capacity to be expected. In this case, 16.4 gallons per foot of drawdown is apparently maximum. It should be kept in mind that this is a conservative method. Using other common methods, higher ideal specific capacities could be derived.

Using another of Jacob's equations, and the portion of the drawdown curves 15 minutes or more after start of pumping, an aquifer transmissibility of 45,500 gpd/ft. was calculated. This is an average for the total formation: shales, siltstones, sands, etc. Some of the conglomerates probably have much higher values, while the clays and shales would be much lower. Transmissibility is just another way of measuring permeability, and is directly proportional to permeability. Transmissibility is the term used in groundwater work and will be used in this report.

Using an effective well radius of 13-3/8", a curve was plotted of drawdown (s) versus radius and time (r^2/t). The data used was a composite of data from several test attempts. Matching this curve against the theoretical "type" curve showed that the rapid initial drawdown gives a transmissibility of approximately 10,000 to 15,000 gpd/ft. Thi is a sharp contrast with aquifer transmissibility. Since it was obtained from the initial portion of the drawdown before the cone of influence has moved out very far, it is a fairly accurate indicator of transmissibilities near the well face.

DISCUSSION

E-log resistivity and self potential data show the best water potential in aquifers at 462-468, 592-598, 760-780, and below 900 feet. Probably only one or two of the upper zones have opened up under present development and have absorbed most of the energy of development efforts to date. This often happens when the surging action is weak, or not prolonged enough.

During the tests, a check was made of water temperatures at the various pumping rates. Temperatures were steady throughout the test at 80° F. The basal zone contains water with temperatures of 130° F. It is believed that if this zone were producing as it should, water temperatures of 90°, or better, should have been measured at the surface.

The shape of the drawdown curve indicates very low transmissibility of the overall aquifer and the evidence from E-logs suggest that a few of the beds have a very high transmissibility. The best conclusion seems to be that the drilling mud has invaded these good production zones, carrying bentonite into the pores and building up a thick mudcake which has not yet broken down. Transmissibility data show a potential yield three to four times the present one. If the aquifers can be opened up, a realistic goal would be one and a half to two times present production rates.

Various methods of development might be tried, as follows:

1. If the well could be pumped down to 400 or 500 feet, some of the mudcake and bentonite might be removed. A pumping volume of about 2700 or 2800 gpm should suffice, for specific capacity is dropping sharply as the drawdown increases, and a heavy drawdown can be expected about 2500 gpm.

2. Perhaps the casing perforations could be used to obtain a jetting action. Two packers could be set at short distances apart. Water pumped from the surface under high pressure and out through the perforations might break up the cake. However, costs would be high. Surging techniques would still be necessary to open up the formation completely.

3. A surging method could be tried using air. Use the same pumping setup as tried already, put an airtight cap over the well, and with an air compressor and three way valve, alternately pump air into the well and release it. A much more effective surging action could be generated in this manner than with a pump. The pump would be necessary for intermittent well clean up and testing. This should develop the well and increase the yield enough to be worthwhile. The method would be best in combination with the heavy pumping already described in the first method.

4. If the water could be pumped from 1000 feet opposite the lower aquifers, some benefit might ensue. Setting pump bowls at this depth would be very expensive, however. An air lift pump could be tried and this would allow the well to be effectively surged also.

It would take a very large air compressor to pump much water from this depth.

References:

Wenzel, L. K., 1942, "Methods for Determining Permeability of Water Bearing Materials." U. S. Geological Survey Water Supply Paper 887

Ferris, J. G., et al, 1962, "Theory of Aquifer Tests". U. S. Geological Survey Water Supply Paper 1536-E

Respectfully submitted,

HEINRICHS GEOEXPLORATION COMPANY

R. W. Davis

R. W. Davis, Geologist

WELL TEST DATA
TABLE I

a. Depths measured from surface by air line
b. Pump bowls set at 444
c. Water temperature was consistently 76.5° F.

Cochise County,
Arizona
NE¼, NE¼, Section 32
T17S, R27E

Date: August 23, 1965

TIME	VOLUME (gpm)	WATER LEVEL (ft.)
9:58	0	134.5
10:00	720	167
10:02	750	171.4
10:03	738	174
10:04	750	174
10:05	738	174
10:10	738	176
10:13	750	176
10:20	738	177
10:25	738	177
10:30	738	177
10:35	765	177
10:40	738	176
10:45	765	176
10:50	738	177
10:55	750	178.35
11:00		
CHANGE SPEED		
11:00.50		233
11:00.67		241
11:00.83		250
11:01.00		255
11:06	1400	267.29
11:10	1450	268
11:15	1450	270.75
11:20	1500	272.67
11:25	1430	272
11:30	1430	270.75
11:35	1450	272
11:45	1450	274.22
11:50	1450	274.22
CHANGE SPEED		
12:01		
12:03	1600	294
12:04	1600	294
12:05	1575	295

WELL TEST DATA
TABLE I

TIME		VOLUME (gpm)	WATER LEVEL (ft.)
12:15		1600	294
12:25		1600	295
12:37		1300	291.54
12:42		950	273
12:45		1040	250
12:50	SHUT DOWN		
12:53			162.2
12:54			150.7
12:55			150.7
12:56			148.5
12:57			148.5
12:58			146
1:00	PM		144
1:05			144
1:10			141.39
1:20			141.39
1:30			139
1:40			139
1:50			137
2:05			135
3:24		0	134
3:25		720	190
3:27		750	185.28
3:29		700	183
3:32		700	187.59
3:37		700	190
3:42		830	194.5
3:47		790	194.52
3:52		815	197
3:55		815	197
3:56	CHANGE SPEED		
3:57		1450	259.2
3:58		1450	265
4:00		1575	267.29
4:04		1540	273
4:09		1540	274.22
4:14		1510	275
4:19		1510	275.37
4:24			
4:27	CHANGE SPEED		
4L27.5		2100	312.33
4:28		1850	317
4:30		1720	317

TIME	VOLUME (gpm)	WATER LEVEL (ft.)
4:32	1660	305.40
4:34	1690	307
4:41	1640	307
4:44	1850	317
4:47	1850	325
AUGUST 24, 1965		
4:29	1160	134
4:29.33	1160	
4:29.50	1160	
4:29.67	1160	210
4:30	1160	211.5
4:30.33	1160	215.3
4:30.67	1160	216.5
4:31	1160	217.5
4:32	1140	220
4:34	1140	221.3
4:39	1140	223.8
4:44	1160	225.7
4:48	1080	224.1
	CHANGE SPEED	
4:48.33	1600	256.2
4:48.50	1600	263.4
4:48.67	1600	268.9
4:49	1600	271.9
4:49.33	1560	272.6
4:49.67	1540	273.1
4:50	1500	270.3
4:51	1500	262.2
4:53	1655	274.9
4:58	1600	268.4
5:03	1400	279.3
5:08	1275	263.4
5:16	1210	269.4
5:28	ENGINE TROUBLE, SHUT DOWN	
	STARTED PUMPING ABOUT 6:30 P.M. - HOLDING STEADY VOLUME	
7:15	1600	290.2

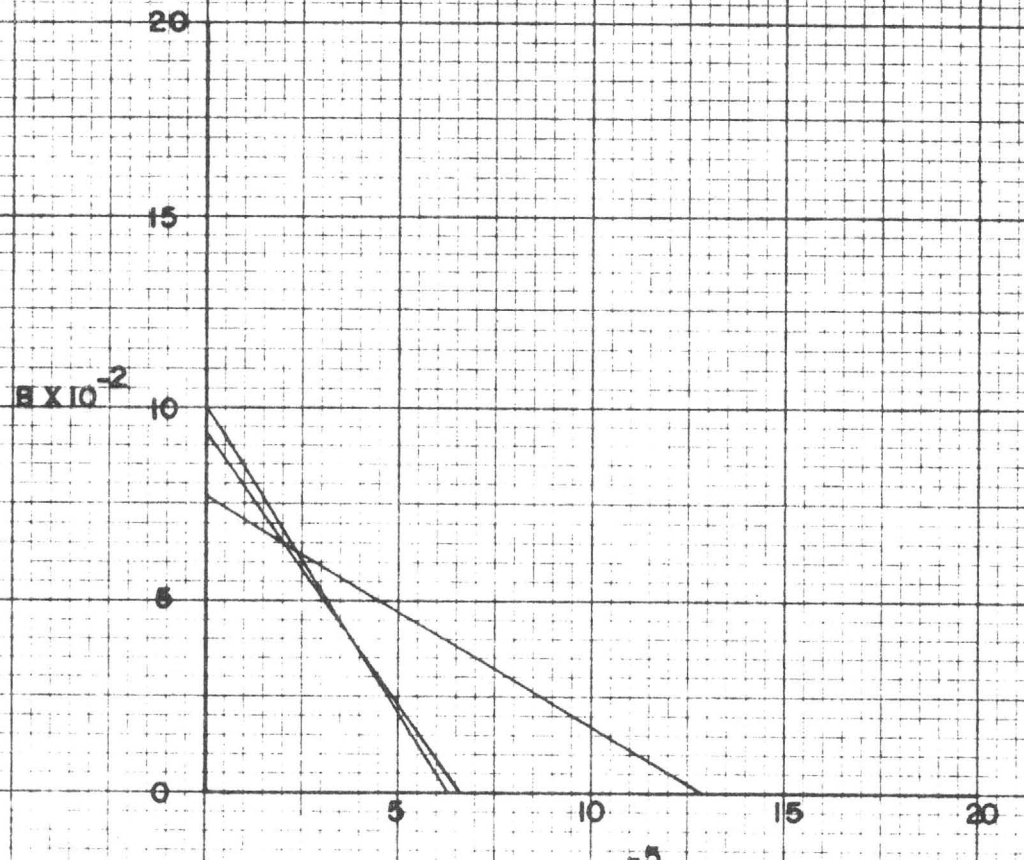


FIG 1

HEINRICHS GEOEXPLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623 0578

GRAPHICAL SOLUTION OF FLOW LOSS COEFFICIENTS. IDEAL SPECIFIC CAPACITY EQUALS RECIPROCAL OF B

FOR
WILLEN CORP
AUGUST 1965

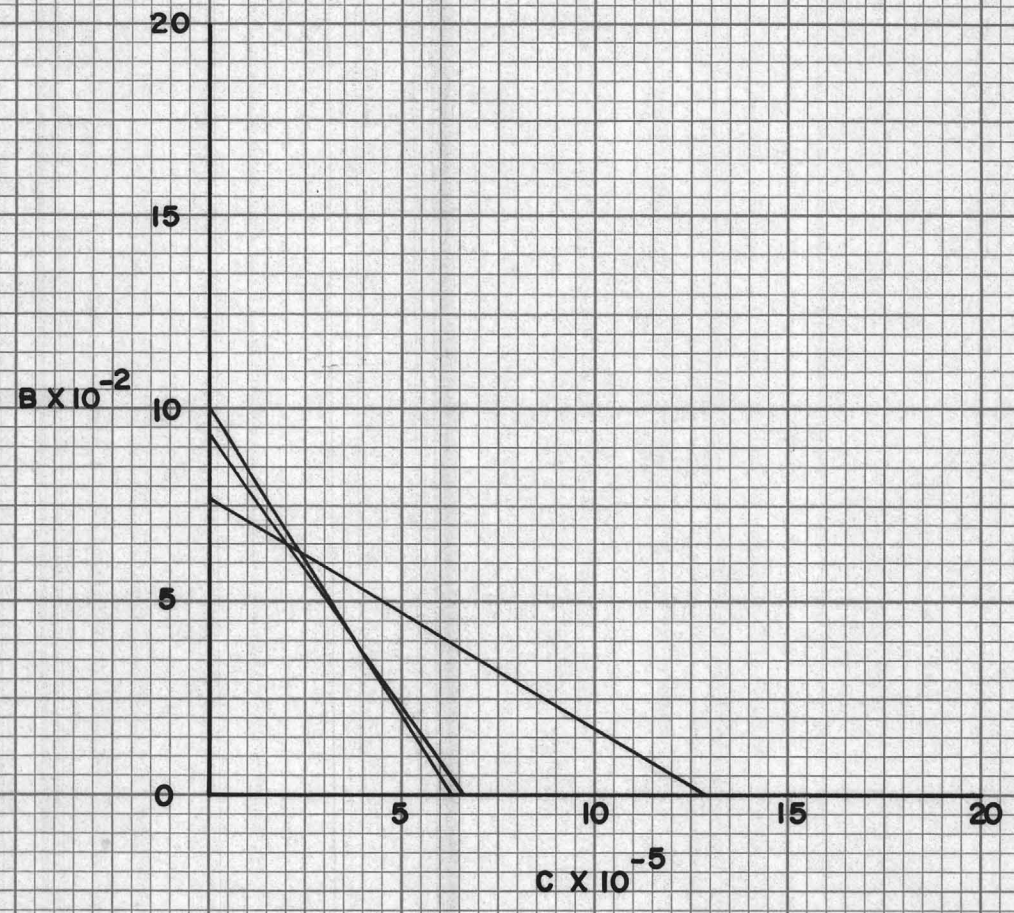


FIG. 1

HEINRICHS *GEOEX*PLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623-0578

GRAPHICAL SOLUTION OF FLOW LOSS COEFFICIENTS. IDEAL SPECIFIC CAPACITY EQUALS RECIPROCAL OF B

FOR
WILLEN CORP.
AUGUST 1965

K&E 10 X 10 TO THE INCH 359-5DG KEUFFEL & ESSER CO. MADE IN U.S.A.

List of Symbols used in Sample Descriptions
(After A.A.P.G.)

SYMBOL	MEANING
abv	above
ang	angular
ark	arkosic
bent	bentonite
brn	brown
cal	caliche
calc	calcareous
cgl	conglomerate
cly	clay
crs	coarse
f	fine grained
fm	formation (geologic rock unit)
frag	fragment (s)
gr	grain
gry	gray
m	medium grained
matl	material
meta	metamorphic
mm	millimeter
mnr	minor
p	poor,poorly
peb	pebbles
por	porosity
pt	part
qtz	quartz
qtzt	quartzite
rd,rdd	round,rounded
s	some
sd	sand (loose grains)
sl	slight
slt,slty	silt,silty
srtd,srtg	sorted, sorting
ss	sandstone (indurated)
subang	subangular
subrd	subrounded
swells	swells when water is added
v	very
vol	volcanic
w	well
w/	with
w/o	without
wh	white

HEINRICHS *GEOEX*PLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623-0578

Sample description from Willen Well
NE 1/4, NE 1/4, Sec. 32, T17S, R27E

August 11, 1965

10' Sd, f - crs, ark, slty
20' Cly, brn, slty, 20% cgl.
30' As above, w/50% cgl.
40' Cly, as above.
50' Crs sd - cgl, p. srtd, ang. vol . peb., ark.
60' As above, 40%; cly, slty, brn, swells, 60%
70' " "
80' Sd, f, slty, sbrd, v.cly, calc, ark.
90' Sd, as abv. except f - m gr.
100' as abv. except f-crs gr.
110' Sd, f-v crs, sbrd-w.rd, ark.
120' Sd, crs, subrd-w.rd, ark 70%; Sd, f, slty, 30%
130' Sd, f-v.crs, sbrd, 70%. Cgl, 3mm, ang, volc. 30%
140' Sd, m-crs, ang w/s cryst qtz, ark., s cgl peb.(Fair aquifer).
150' Sd, as above, 50%; cgl, 2-3mm, vol. ped. ang.
160' Sd, as at 140'
170' - 190- As above with more v crs. matl.
Fm change
200' Sd, v crs, ang, ark w/volc. peb.
210' Sd, f-crs, ang, ark, 70%; Cgl, 3mm, ang, vol. peb., 30%
220' - 240' Cgl, 2-4mm, ang, vol , & meta. peb.
250' - 300' Cgl, 3-5mm, ang-sbrd, vol. peb. wh qtzt, meta. peb.
(poss. good aquifer)
310' As above w/ Sd, F-crs, ang-sbrd, ark, 50%, calc.
320' - Cgl, 2mm-10mm, w rdd peb, vol. peb-mostly rhyolite,
(good aquifer)
330' - Cgl, 2-5mm, sbrd-w.rd, vol. peb., meta peb, 50%; Sd,
f-m, ang, slty & cly in pt, 50%, calc.
340' - Cgl, as above 70%; Sd, as ab. 30%.
350' - Sd, m-v crs, ang, ark., many qtz frag., ark, calc;
some Cgl, as in 340'.
360' - As abv; Sd, 50%; Cgl, 50%
370' - Cgl, as abv. 30%; Cly, sd & slt., 70%, calc.
380 - 400 - Cgl, as above 50%; Cly, sd & slt 50% calc.
410' - 420'- Cgl, as above w/ some caliche coating & Cu stain,
70%; Cly, sd & slt, as abv. 30%
430' - Cgl, 2-5mm, sbrd, some cal. coating; vol. peb.
440' - as above
450' Cgl, 5 - 10 mm, ang-sbrd, vol. peb., 20% Cgl, 2mm, ang-sbrd,
60%, Cly, brn, sdy, 20%, calc.
460' - 500' Cgl, 2-3mm, sbrd, vol & meta peb.
510' - Cgl, as above - 50%; sd, v crs, ark, ang, 40%; cly 10%
520' - 550' - Cgl, as at 460'
560' - Cgl, as abv w/some sdy cly.
570' - 580' - Cgl as at 460'
590' - Sd, v crs, ang, & cgl, 2-3mm, ang, ark., 40%. Cly, brn,
calc, 60%.
600' - 700'- Cgl, more than 4mm, sb ang-ang, vol, meta & qtzt
frag, 30%; Sd, m-v crs, ang-subrd, ark, 70%
Poss well cemented.

(more)

710' - as above w/ some clay (less than 10%)
720' - as above w/o clay
730' - as above w/ some clay, brn.
740' - Cgl, as abv, 30%; cly as abv, 70%
750' 760' - as above
770' - Sd, m-v crs, w rdd-sb ang, ark.
780' - Sd, m-crs, rdd-ang, ark, fr. sttg, (good aquifer)
790' - 810' As above w/some f gr sd (poss tight)
820' - Cgl as at 460'
830' - Sd as at 790'
840' - Cgl, 2-3mm, rdd-ang, vol, meta & qtzt peb, 70%; sd, f-crs, ang-sbrdd, cly, slty, 30%
850' - 870' - Cgl as at 460'
880' - As above, 60%; cly, brn, slty, 40%
890' - Sd, m-v crs, ang-sbrdd, ark, (Looks hard on bits)
900' - Sd, M-v crs, ang - sub ang, ark, frag of gry qtzt sd, (looks hard)
910-960' - as above
970' - Sd, f-crs, ang, ark
980' - as above
990' - Sd as at 900' w/pyrite
1000' - Cgl, less than 3mm, ang, vol. frag., 20%
Sd, m w/mnr crs, Sb ang - w rdd, ark, 80%
1010' as above w/mnr cly.
1020' - Sd, mstly f w/m & mnr crs, ang, ark, p. por (?)
1030' - Sd, as abv; v mnr bent.
1040'- Sd, f-vf, subang, sl ark, m sttg, 80%. Sd, v crs, subang, frag vol, meta, 20%
1050' - Cgl & v crs sds, ang, frag. andesite porphyry, meta, qtzt.
1060' - Sd, m-crs, subang - sbrdt, ark, m sttg, w/mnr cgl.
1070' - Sd, as abv, w/s v crs frag meta, vol, qtzt; one ball graphite, prob from rig.
1080' - 1090' - Sd, v crs & cgl, less than 3mm, frag, vol, meta, qtzt., all sbang-sbrdd, prob. good por.
1100' - Sd & cgl, as abv, 70%; sd, f-m, w rdd - sbang, ark, 30%
1110' - no sample
1120' - Sd, m- v crs, cgl, rdd-ang, ark, p. srtd.
1130' - 1140' - Sd, f-m, sbang- w rdd, ark, f por
1150' - Sd, crs, ang, ark, frag vol, meta, qtzt.
1160' - 1170' - Sd, as at 1120' - 1130'

Drilled with rotary rig.
Samples from return pipe.
Depths from top of rig floor 5 ft. above ground surface.
Drilled to 1010' and E-logged on August 5, 1965
Back in hole and drilled to T.D. at 1170 ft. on August 7, 1965.

Rough field computations using Rorabaugh

$n = 1.5$

① $43 = 740B + 740^{1.5}C$ $\quad B = 5.81 \times 10^{-2}$ $\quad C = 21.07 \times 10^{-4}$

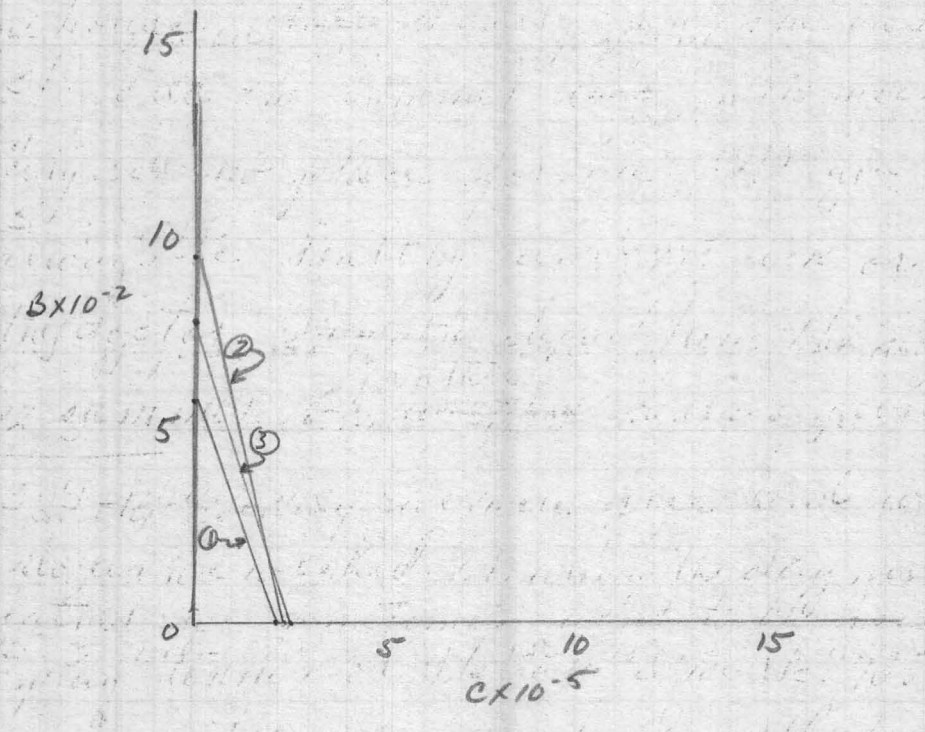
$= 740B + 204 \times 10^{-2}C$

② $140 = 1450B + 1450^{1.5}C$ $\quad B = 9.65 \times 10^{-2}$ $\quad C = 24.95 \times 10^{-4}$

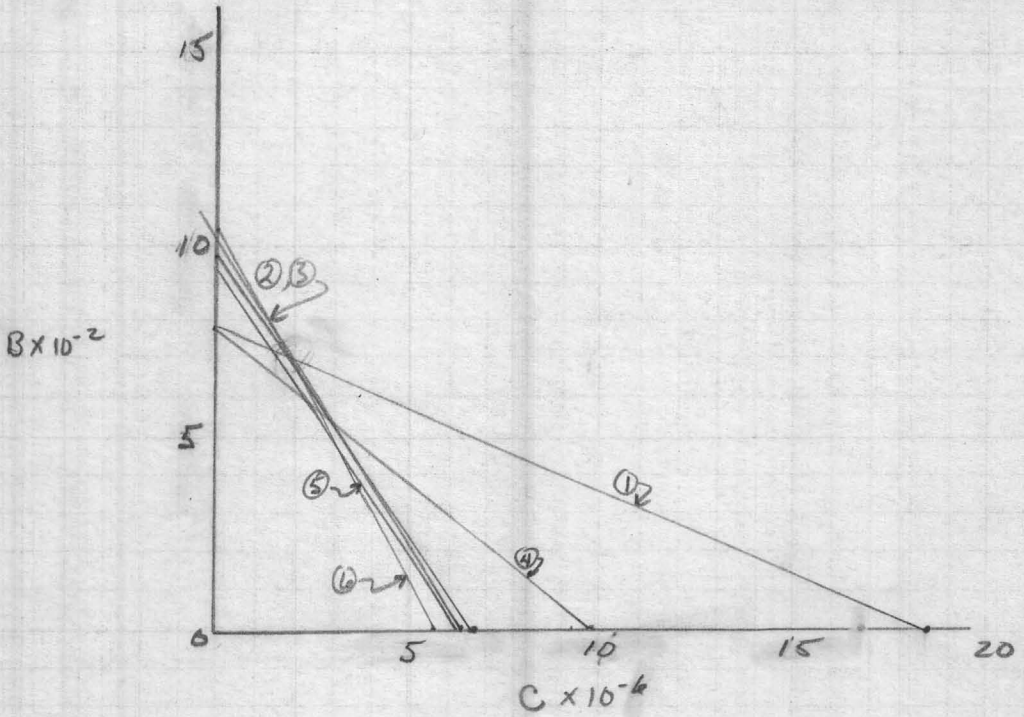
$= 1450B + 562 \times 10^{-2}C$

④ $63 = 800B + 800^{1.5}C$ $\quad B = 7.87 \times 10^{-2}$ $\quad C = 25.2 \times 10^{-4}$

$= 800B + 250 \times 10^{-2}C$



Rough Field Computation of well efficiency 8-23-65



444
118
326

2.31
51
231
1155
1787

@ 740 gpm

① $43 = 740B + (740)^2C$
$= 740B + 550 \times 10^3 C$

② $140 = 1450B + (1450)^2C$
$= 1450B + 210 \times 10^4 C$

③ $160 = 1600B + (1600)^2C$
$= 1600B + 256 \times 10^4 C$

1 hr dd

? → ④ $63 = 800B + 64 \times 10^4 C$

½ hr d.d.

⑤ $141 = 1520B + (1520)^2C$
$= 1520B + 231 \times 10^4 C$

? → ⑥ $191 = 1850B + (1850)^2C$

@ B = 0 @ C = 0

$C = 18.5 \times 10^{-5}$ $B = 7.8 \times 10^{-3}$

$C = 6.7 \times 10^{-5}$ $B = 9.7 \times 10^{-2}$

$C = 6.23 \times 10^{-5}$ $B = 10 \times 10^{-2}$

$C = 9.85 \times 10^{-5}$ $B = 7.86 \times 10^{-2}$

$C = 6.11 \times 10^{-5}$ $B = 9.28 \times 10^{-2}$

$C = 5.6 \times 10^{-5}$ $B = 10.31 \times 10^{-2}$

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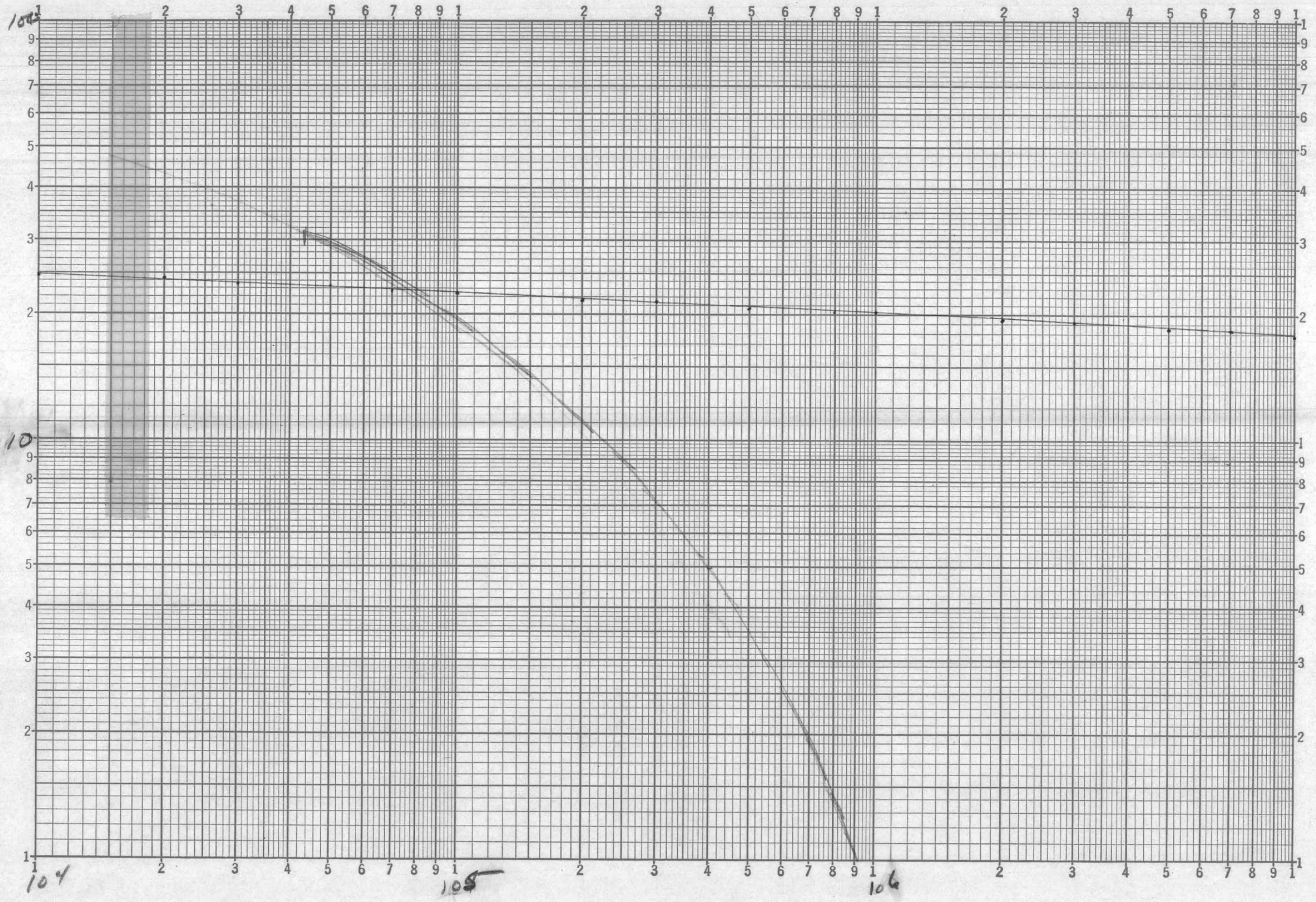
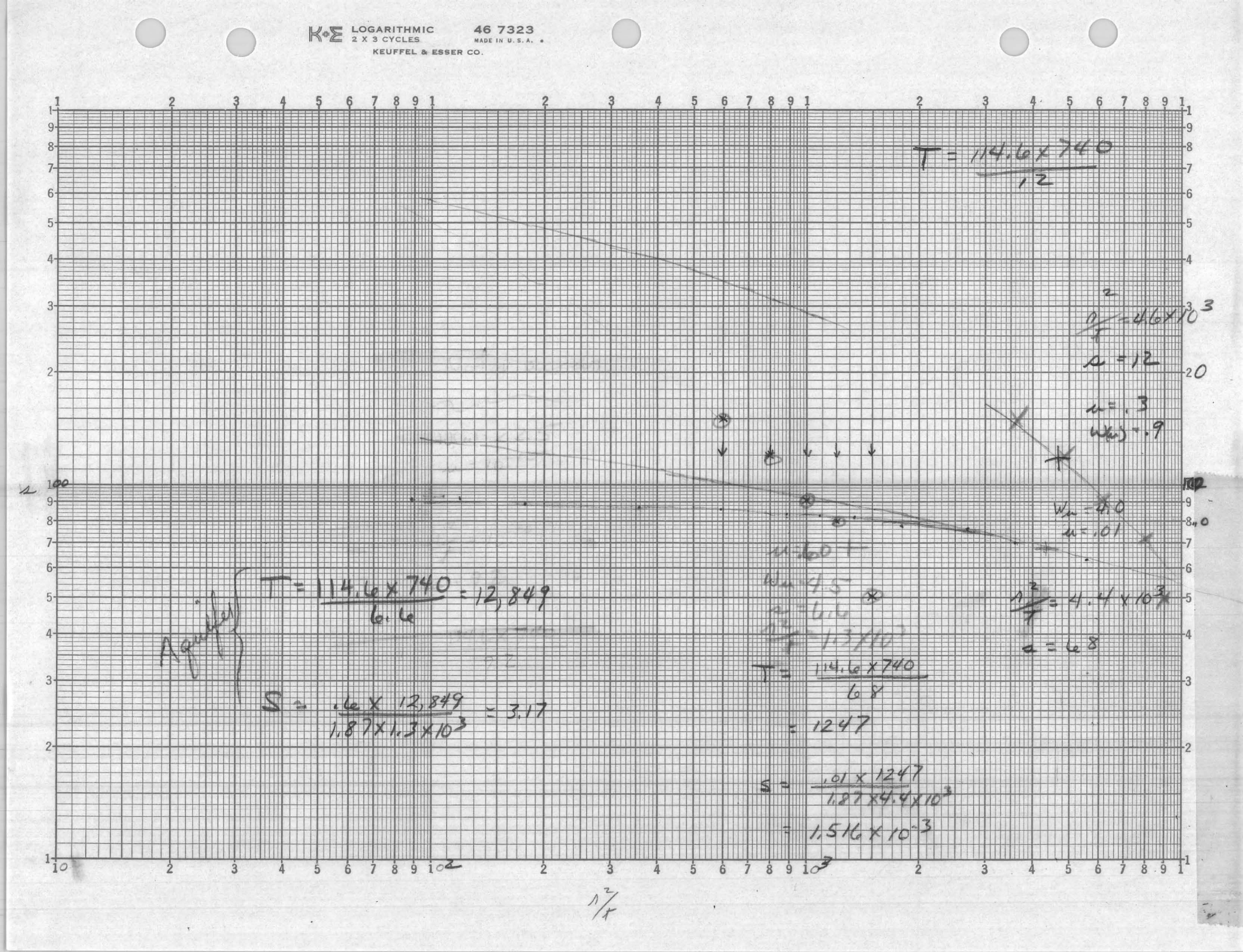
2 X 3 CYCLES MADE IN U.S.A.
KEUFFEL & ESSER CO.

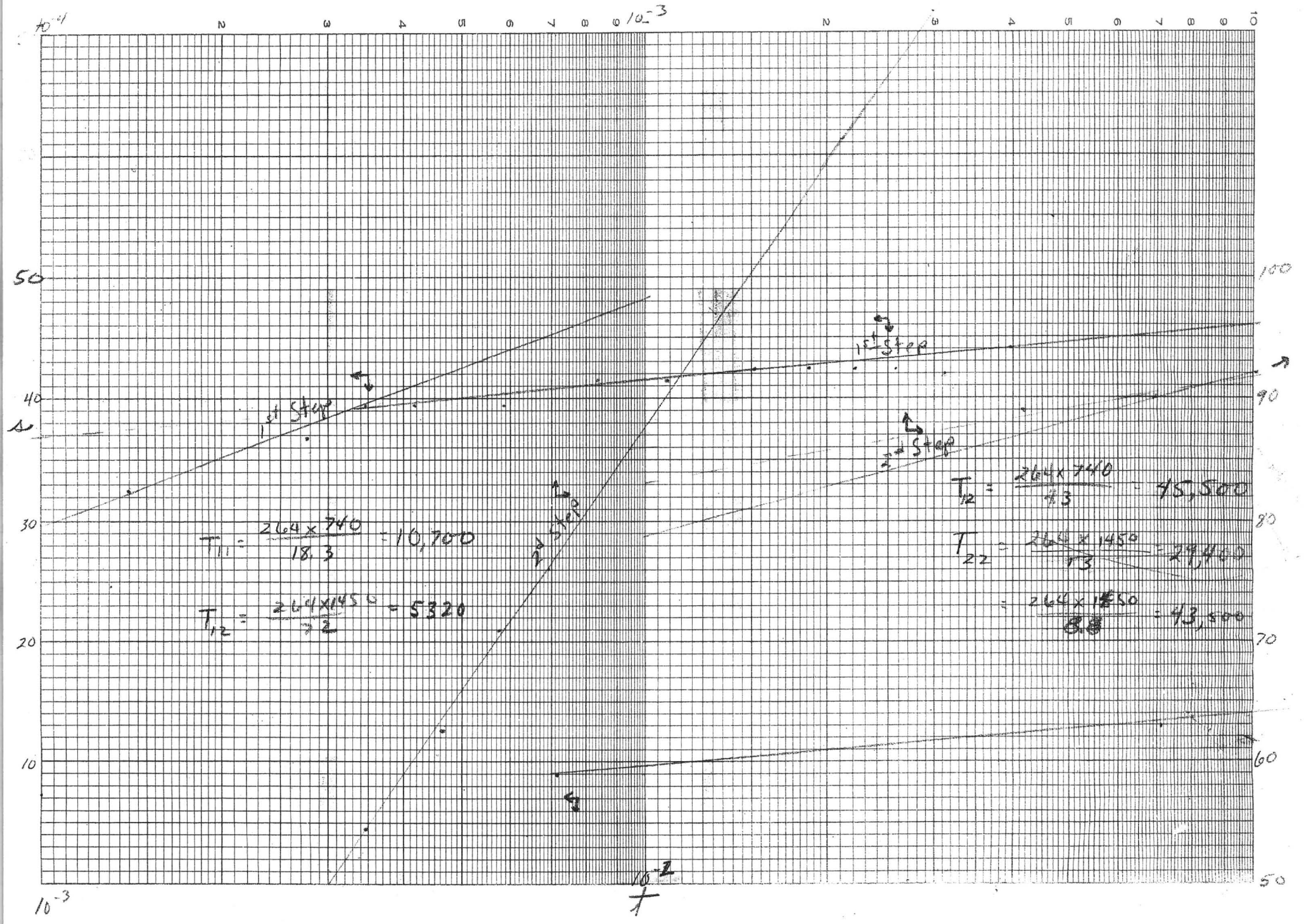


K+E LOGARITHMIC 46 7323
2 X 3 CYCLES MADE IN U.S.A.
KEUFFEL & ESSER CO.



NO. 340R-L210 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 10 DIVISIONS PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.



DEVELOPMENT OF WILLEN WELL
NE ¼, NE ¼, SECTION 32
T 17 S, R 27 E

For

Willen Corporation

August 1965

by

Heinrichs Geoexploration Company
P. O. Box 5671 Tucson, Arizona

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STEP DRAWDOWN TESTS

DEVELOPMENT OF WILLEN WELL

For Willen Corporation August 1965

INTRODUCTION

Heinrichs Geoexploration Company was requested to outline the procedures for developing a well drilled at Sunizona Acres in the NE ¼, NE ¼, Section 32, T 17 S, R 27 E. These procedures were carried out by Gilbert Pump of Tucson, Inc., Tucson, Arizona.

Testing was started about August 20, 1965 by Gilbert. On August 23, 1965, R. W. Davis of Geoex went to Sunizona to observe a step drawdown test. Some minor development work was done also to see if yields could be increased. Development and testing were halted on August 24, 1965. The test records were analyzed by R. W. Davis.

SUMMARY AND CONCLUSIONS

The well appears to be capable of producing at least one and a half times what it is now. Present specific capacity is about 10.5 gallons per foot of drawdown. The main deterrent to good production is probably drilling mudcake and/or bentonite.

Three methods of further development are offered for consideration:

1. If the well could be pumped down to 400 or 500 feet, some of the mud might come loose.

2. Water could be pumped under high pressure into a zone between two packers and forced at high velocity into the gravel pack. The jetting action might break up any drilling mudcake.

3. Compressed air might be used to set up a more efficient surging action.

4. Pumping from opposite the deeper aquifers would be beneficial.

Before proceeding with more development, however, the results of developing another well should be evaluated. It is understood that another is planned in this section. If that well is completed as the present one, and then developed by somewhat different techniques, the relative worth of the two methods could be evaluated. Also, if tests show that further development would not eliminate

the need for a third or fourth well, this would have a bearing on the final decision.

PROCEDURE

Gilbert Pump was instructed to develop the well according to their standard procedures. When they felt that it was sufficiently developed, a step drawdown test was run. Gilbert pumped the well for ten hours. After approximately nine hours, the well cleared. Gilbert personnel did not feel that surging or other development would improve yields.

A step drawdown test is a fairly common method of evaluating the efficiency of a well. In order to obtain reliable results, at least three steps are ordinarily demanded. Only two definitive steps were obtained in this test, although three attempts were made to get more. However, enough information was gained to reach some conclusions. A chart of the step drawdown tests is included with this report.

During the course of the test, five hours were used to alternately pump and surge the well. A pumping rate of 2200 gpm was maintained for as much as thirty minutes at a time. The surge cycle was about 50-60 seconds in period. The well was pumped until water reached the surface, usually about ten seconds, and then the water was allowed to drain back. This produced a strong inwash, but a rather weak backwash. The surging action did produce some sand and is believed to have increased the specific capacity about 10% although this is hard to evaluate positively.

CALCULATIONS

A method devised by Jacob for the U. S. Geological Survey from empirical data gives the most conservative estimate of flow losses:

$$s = BQ + CQ^2$$

where s = residual drawdown
Q = pumping rate (gpm)
B = laminar flow loss factor
C = turbulent flow loss factor

Taking data from the test begun on August 23 at 10:00 and using drawdowns at 20 minutes after start of each step:

Step	Formula	At C=0	At B=0
1	$43=740B + (550X10^{3})C$	$B=7.81X10^{-2}$	$C=12.8X10^{-5}$
2	$137=1450B + (210X10^{4})C$	$B=9.45X10^{-2}$	$C=6.5X10^{-5}$
3	$161=1600B + (256X10^{4})C$	$B=10.1X\ 10^{-2}$	$C= 6.29X10^{-5}$

Step three was not large enough to be definitive. A faulty pump motor prevented adequate drawdown from being achieved.

Figure I is a graph of the three equations. At the best intersection of the lines, ($B=6.2X10^{-2}$), the reciprocal of B is the ideal specific capacity of the well. That is, it indicates the maximum specific capacity to be expected. In this case, 16.4 gallons per foot of drawdown is apparently maximum. It should be kept in mind that this is a conservative method. Using other common methods, higher ideal specific capacities could be derived.

Using another of Jacob's equations, and the portion of the drawdown curves 15 minutes or more after start of pumping, an aquifer transmissibility of 45,500 gpd/ft. was calculated. This is an average for the total formation: shales, siltstones, sands, etc. Some of the conglomerates probably have much higher values, while the clays and shales would be much lower. Transmissibility is just another way of measuring permeability, and is directly proportional to permeability. Transmissibility is the term used in groundwater work and will be used in this report.

Using an effective well radius of 13-3/8", a curve was plotted of drawdown (s) versus radius and time (r^2/t). The data used was a composite of data from several test attempts. Matching this curve against the theoretical "type" curve showed that the rapid initial drawdown gives a transmissibility of approximately 10,000 to 15,000 gpd/ft. Thi is a sharp contrast with aquifer transmissibility. Since it was obtained from the initial portion of the drawdown before the cone of influence has moved out very far, it is a fairly accurate indicator of transmissibilities near the well face.

DISCUSSION

E-log resistivity and self potential data show the best water potential in aquifers at 462-468, 592-598, 760-780, and below 900 feet. Probably only one or two of the upper zones have opened up under present development and have absorbed most of the energy of development efforts to date. This often happens when the surging action is weak, or not prolonged enough.

During the tests, a check was made of water temperatures at the various pumping rates. Temperatures were steady throughout the test at 80° F. The basal zone contains water with temperatures of 130° F. It is believed that if this zone were producing as it should, water temperatures of 90°, or better, should have been measured at the surface.

The shape of the drawdown curve indicates very low transmissibility of the overall aquifer and the evidence from E-logs suggest that a few of the beds have a very high transmissibility. The best conclusion seems to be that the drilling mud has invaded these good production zones, carrying bentonite into the pores and building up a thick mudcake which has not yet broken down. Transmissibility data show a potential yield three to four times the present one. If the aquifers can be opened up, a realistic goal would be one and a half to two times present production rates.

Various methods of development might be tried, as follows:

1. If the well could be pumped down to 400 or 500 feet, some of the mudcake and bentonite might be removed. A pumping volume of about 2700 or 2800 gpm should suffice, for specific capacity is dropping sharply as the drawdown increases, and a heavy drawdown can be expected about 2500 gpm.

2. Perhaps the casing perforations could be used to obtain a jetting action. Two packers could be set at short distances apart. Water pumped from the surface under high pressure and out through the perforations might break up the cake. However, costs would be high. Surging techniques would still be necessary to open up the formation completely.

3. A surging method could be tried using air. Use the same pumping setup as tried already, put an airtight cap over the well, and with an air compressor and three way valve, alternately pump air into the well and release it. A much more effective surging action could be generated in this manner than with a pump. The pump would be necessary for intermittent well clean up and testing. This should develop the well and increase the yield enough to be worthwhile. The method would be best in combination with the heavy pumping already described in the first method.

4. If the water could be pumped from 1000 feet opposite the lower aquifers, some benefit might ensue. Setting pump bowls at this depth would be very expensive, however. An air lift pump could be tried and this would allow the well to be effectively surged also.

It would take a very large air compressor to pump much water from this depth.

References:

Wenzel, L. K., 1942, "Methods for Determining Permeability of Water Bearing Materials." U. S. Geological Survey Water Supply Paper 887

Ferris, J. G., et al, 1962, "Theory of Aquifer Tests". U. S. Geological Survey Water Supply Paper 1536-E

Respectfully submitted,

HEINRICHS GEOEXPLORATION COMPANY

R. W. Davis

R. W. Davis, Geologist

WELL TEST DATA
TABLE I

a. Depths measured from surface by air line
b. Pump bowls set at 444
c. Water temperature was consistently 76.5° F.

Cochise County,
Arizona
NE¼, NE½, Section 32
T17S, R27E

Date: August 23, 1965

TIME	VOLUME (gpm)	WATER LEVEL (ft.)
9:58	0	134.5
10:00	720	167
10:02	750	171.4
10:03	738	174
10:04	750	174
10:05	738	174
10:10	738	176
10:15	750	176
10:20	738	177
10:25	738	177
10:30	738	177
10:35	765	177
10:40	738	176
10:45	765	176
10:50	738	177
10:55	750	178.35
11:00		
CHANGE SPEED		
11:00.50		233
11:00.67		241
11:00.83		250
11:01.00		255
11:06	1400	267.29
11:10	1450	268
11:15	1450	270.75
11:20	1500	272.67
11:25	1430	272
11:30	1430	270.75
11:35	1450	272
11:45	1450	274.22
11:50	1450	274.22
CHANGE SPEED		
12:01		
12:03	1600	294
12:04	1600	294
12:05	1575	295

TIME		VOLUME (gpm)	WATER LEVEL (ft.)
12:15		1600	294
12:25		1600	295
12:37		1300	291.54
12:42		950	273
12:45		1040	250
12:50	SHUT DOWN		
12:53			162.2
12:54			150.7
12:55			150.7
12:56			148.5
12:57			148.5
12:58			146
1:00	PM		144
1:05			144
1:10			141.39
1:20			141.39
1:30			139
1:40			139
1:50			137
2:05			135
3:24			
3:25		0	134
3:27		720	190
3:29		750	185.28
3:32		700	183
3:37		700	187.59
3:42		700	190
3:47		830	194.5
3:52		790	194.52
3:55		815	197
3:56	CHANGE SPEED	815	197
3:57			
3:58		1450	259.2
4:00		1450	265
4:04		1575	267.29
4:09		1540	273
4:14		1540	274.22
4:19		1510	275
4:24		1510	275.37
4:27	CHANGE SPEED		
4L27.5			
4:28		2100	312.33
4:30		1850	317
		1720	317

TIME	VOLUME (gpm)	WATER LEVEL (ft.)
4:32	1660	305.40
4:34	1690	307
4:41	1640	307
4:44	1850	317
4:47	1850	325
AUGUST 24, 1965		
4:29	1160	134
4:29.33	1160	
4:29.50	1160	
4:29.67	1160	210
4:30	1160	211.5
4:30.33	1160	215.3
4:30.67	1160	216.5
4:31	1160	217.5
4:32	1140	220
4:34	1140	221.3
4:39	1140	223.8
4:44	1160	225.7
4:48	1080	224.1
CHANGE SPEED		
4:48.33	1600	256.2
4:48.50	1600	263.4
4:48.67	1600	268.9
4:49	1600	271.9
4:49.33	1560	272.6
4:49.67	1540	273.1
4:50	1500	270.3
4:51	1500	262.2
4:53	1655	274.9
4:58	1600	268.4
5:03	1400	279.3
5:08	1275	263.4
5:16	1210	269.4
5:28	ENGINE TROUBLE, SHUT DOWN	
STARTED PUMPING ABOUT 6:30 P.M. - HOLDING STEADY VOLUME		
7:15	1600	290.2

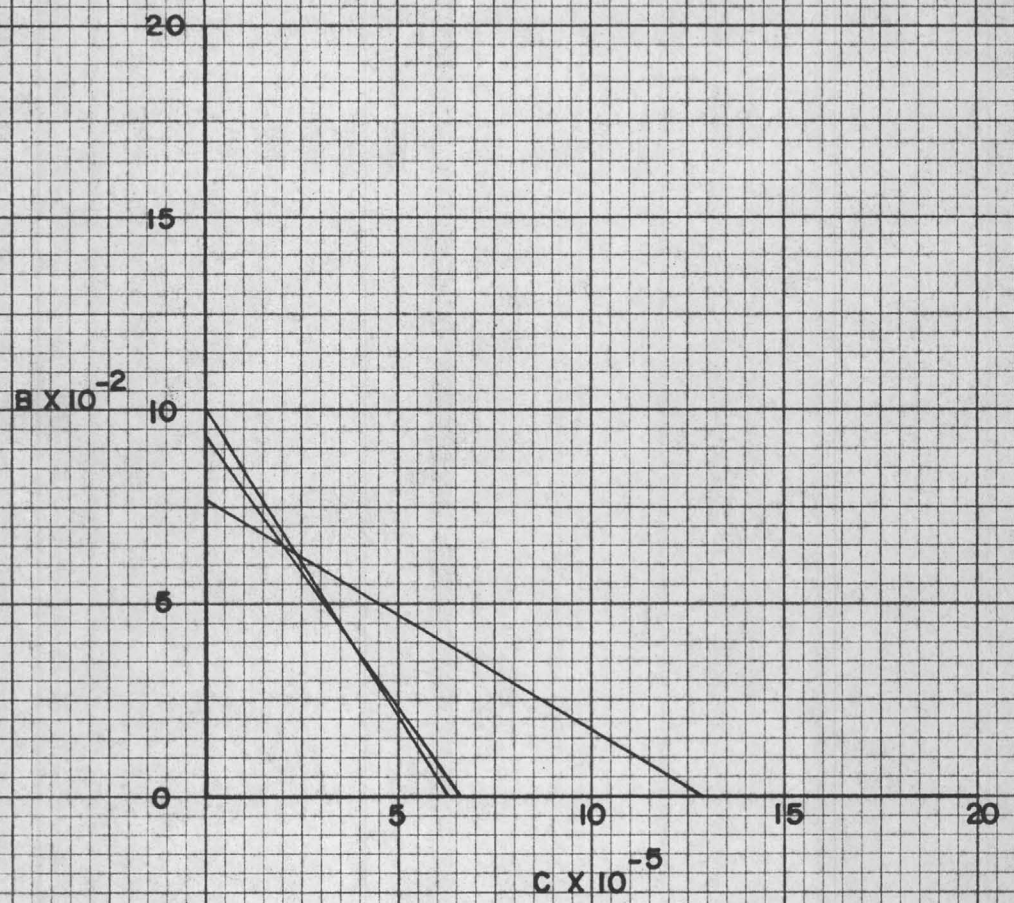
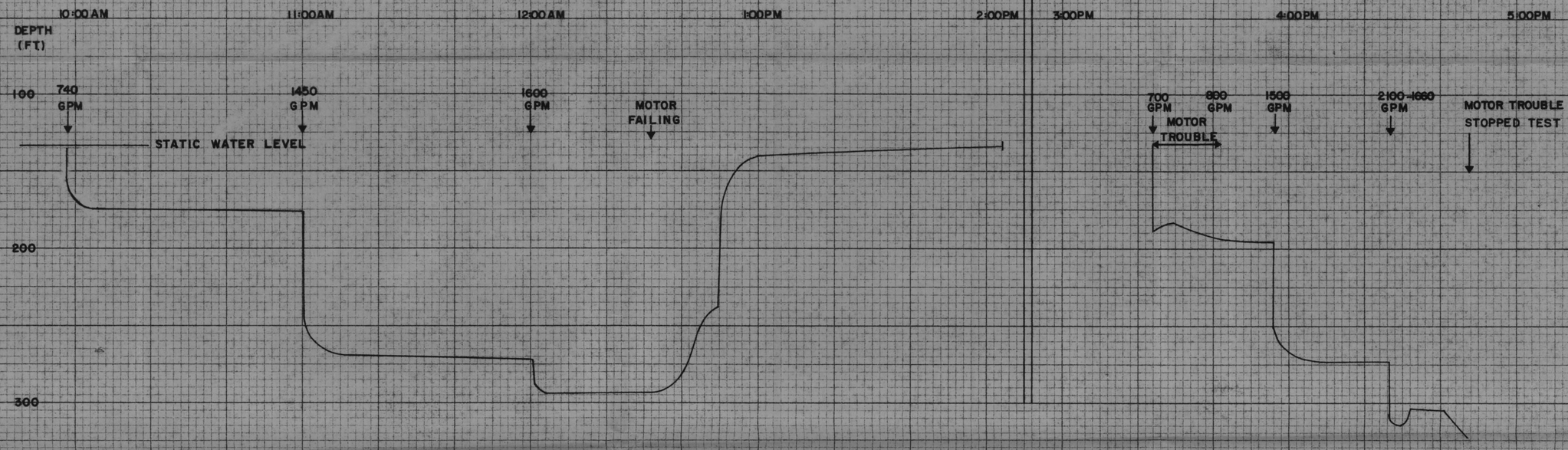


FIG. 1

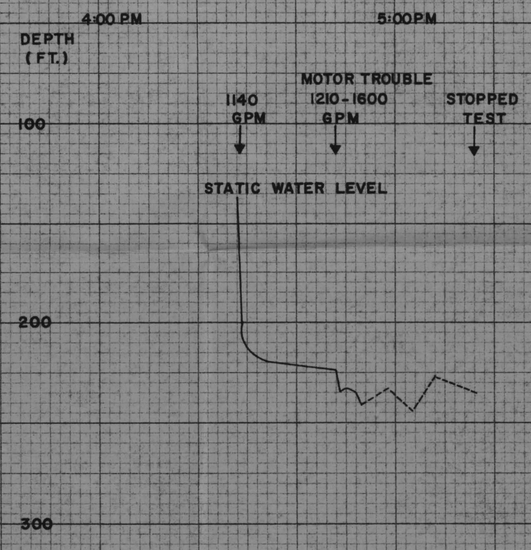
HEINRICHS GEOEXPLORATION CO.
BOX 5671 TUCSON, ARIZONA 85703
Phone: (AREA 602) 623-0578

GRAPHICAL SOLUTION OF FLOW LOSS COEFFICIENTS. IDEAL SPECIFIC CAPACITY EQUALS RECIPROCAL OF B

FOR
WILLEN CORP.
AUGUST 1965



TEST OF AUGUST 23, 1965



TEST OF AUGUST 24, 1965

HEINRICHS GEOEXPLORATION CO.
POST OFFICE BOX 5671, TUCSON, ARIZONA, 85703

STEP DRAWDOWN TESTS
NE 1/4 NE 1/4 SEC. 32 T17S - R27E
COCHISE COUNTY, ARIZONA
FOR

WILLEN CORP.

Scale | Date AUG 1965

ANDERSON IRRIGATION DRILLING CO.

P.O. Box 924
Wichita Falls, Texas

P.O. Box 840
Douglas, Arizona
Phone 602-364-3361

DRILLING TIME LOG
FOR:

WILLEN CORPORATION WELL #1

NE ¼ Sec. 32

Prepared By: H. E. Anderson

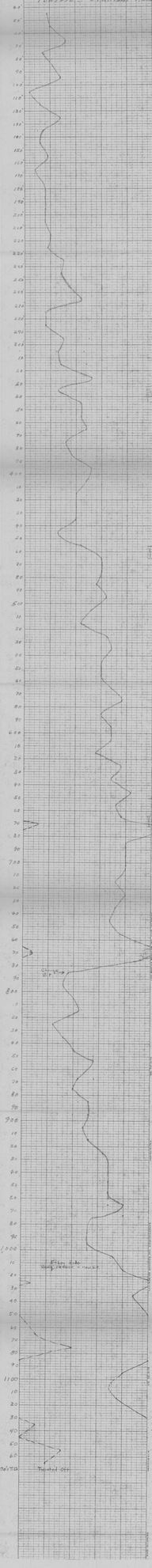
Hole Size = 15"

Drilling Time / 10' Interval
Minutes
5 10 15 20 25

Spud 8/3/65

Kelley Drilling
Very Slow
Purpose? Straight Hole

Depth



INSTRUCTIONS FROM MAX EASTMAN :

1. Use rotary rig drilling and LIGHTWEIGHT BENTONITE mud.

NE¼, NE¼ Sec 32, T17S R27E

2. Drill 15" investigation hole to approximately 1000 ft.
   If Andexsite or other hard formations are encountered below 750 ft, stop at that depth.
   If it is found above 750 ft, try to penetrate the hard formation.
   Take and save adequate ditch samples while drilling.

3. Run an electric log at total depth, using both resistivity and self-potential curves.

4. Based on cuttings inspection and the electric log, open hole to 26 3/4 inches to base of lower most fresh water productive horizon.

5. If no salt water sands are encountered, leave the hole open below the large hole, otherwise plug the 15 inch hole with cement.

6. Run 16" casing to the depth that the hole has been opened to 26 3/4".
   1/4" wall thickness is adequate for depths up to 900 ft. If greater lengths are required, additional lengths should be of 5/16" wall - added to top of casing.

7. The perforated sections should be from the top of the uppermost productive horizons to the bottom of the casing.
   The slots should be either machine cut or torch cut and should be approximately 1/8" to 3/16" in width and length and number customarily used.
   It is desireable to have the pump bowls set in the blank portions of the casing; therefore any doubtfully productive horizons at the top should be covered by blank casing.

8. Thin the mud with water and gravel pack the annulus with 1/4" to 3/8" gravel. Size will be influenced by grain size of sand in the cuttings. Wash annulus with fresh water and pack in as much gravel as possible.

9. Develop well with fast bailing technique until clear water is obtained.

10. Release rig.

11. Test well with adequate test equipment.

12. Take 10' samples from surface to T.D.

Doc: Kay Richardson asked me to ask you to call Max Eastman to discuss any of the above instructions that are not clear or that you differ with.

Al. Erickson

7/29/65

List of Symbols used in Sample Descriptions
(After A.A.P.G.)

SYMBOL	MEANING
abv	above
ang	angular
ark	arkosic
bent	bentonite
brn	brown
cal	caliche
calc	calcareous
cgl	conglomerate
cly	clay
crs	coarse
f	fine grained
fm	formation (geologic rock unit)
frag	fragment (s)
gr	grain
gry	gray
m	medium grained
matl	material
meta	metamorphic
mm	millimeter
mnr	minor
p	poor,poorly
peb	pebbles
por	porosity
pt	part
qtz	quartz
qtzt	quartzite
rd,rdd	round,rounded
s	some
sd	sand (loose grains)
sl	slight
slt,slty	silt,silty
srtd,srtg	sorted, sorting
ss	sandstone (indurated)
subang	subangular
subrd	subrounded
swells	swells when water is added
v	very
vol	volcanic
w	well
w/	with
w/o	without
wh	white

ELECTRIC LOG

Owner: Willen Corp.
Location: 370' So. of No. Line
70' W. of E. Line
Sec. 32, T 17S, R27E
Elevation: 4402'
Datum: Ground Surface
Bottom Hole Temp.: 130°F

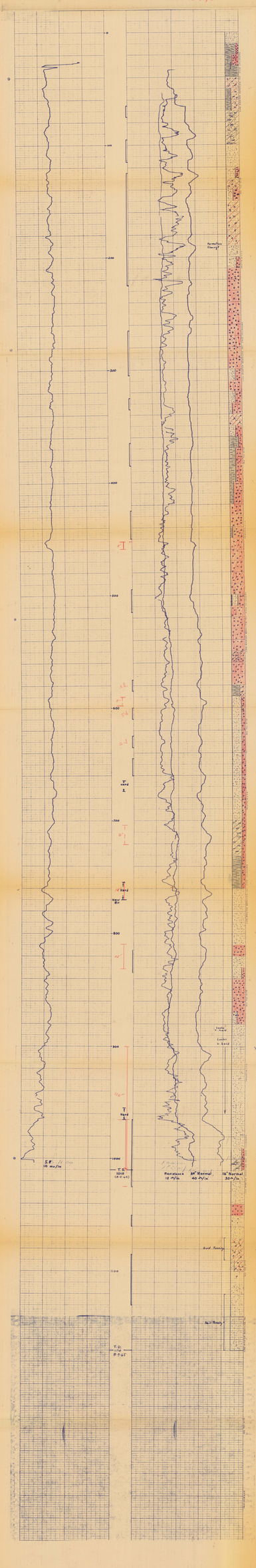
Logged by: Southwestern Geophysics 8-5-65
Drilled by: "Doc" Anderson
Analyzed & Edited by: Heinrichs Geoexploration (R.W.D.)

Logs:
S.P.
10 mv/in

Drilling Breaks

Logs:
Resistivity
13 Ω/in

64" Normal
40 Ω/in

16" Normal
30 Ω/in

Washed Samples from overflow at surface Pipe