Texas Water Development Board

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Open-File Report

Data and Results from an Aquifer Test Performed at the Medina Water Supply Corporation Well Field, Medina, Texas

by
Robert G. Bradley,
Douglas B. Coker,
and
Stephen W. Moore

August 1997

Table of Contents

Figures

Tables

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Introduction

On August 5 and 6, 1997, Robert Bradley, Doug Coker, and Steve Moore of the TWDB Water Supplies Section conducted an aquifer test in Medina, Texas (Figure 1). The test was conducted to determine if additional water could be produced from the existing Medina WSC wells used for public supply for the community of Medina in Bandera County.

The three wells used in the test are completed in the middle and lower Trinity aquifer. Well No. 1 is completed in the Cow Creek Limestone and Hosston Sand. Well No. 2 is completed in the Hensell Sand and Cow Creek Limestone. Well No. 3 is completed in the lower Glen Rose Limestone, Hensell Sand, and Cow Creek Limestone. Medina WSC uses wells No. 1 and 3 for production and well No. 2 is not in use. The physical characteristics of the geologic units at the test site are:

Geologic Unit		Hydrologic Unit	Approximate Maximum Thickness (feet)	Character of Rocks	Water-Bearing Proprieties
Glen Rose Limestone	Lower member	Middle Trinity	300	Massive Limestone	Yields small to moderate quantities of fresh to slightly saline water.
Hensell Sand			140	Red to gray clay, silt, sand and conglomerate	
Cow Creek Limestone			90	Massive limestone	
Hammett Shale			50	Dark gray to blue shale	Yields no water
Hosston Sand		Lower Trinity	370	Red and white conglomerate, sandstone, shale, and limestone	Yields small to large quantities of fresh to slightly saline water.

The following table describes the characteristics of the three wells at the test site.

Medina WSC Well No.	State Well No.	Test Use	Depth	Screened Interval
Number 1	69-14-601	Observation	±500	400 - ±500
Number 2	69-14-604	Observation	406	235 - 406
Number 3	69-14-606	Pump	420	150 - 170, 312 - 400

Aquifer Test Description

An aquifer test establishes the hydraulic characteristics of an aquifer, which are typically described using transmissivity and storage coefficient. Transmissivity is the amount of water that will move in a unit time through a vertical strip of the aquifer one unit wide, under a hydraulic gradient of one. Storage in confined aquifers is described as storage coefficient. This is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

Well No. 3 was used as the pumped well and wells No. 1 and 2 were used as observation wells. Measurements were made in all of the wells prior to pumping to determine a recovery trend and static water level. Water-level measurements were made using E-lines throughout the test. Discharge of pumping well No. 3 was measured using an electronic flowmeter placed on the discharge pipe. Pumping lasted 12 hours and recovery was measured for 12 hours (Tables 1 and 2). Well discharge ranged from approximately 171 gpm at the beginning of pumping to 104 gpm during later portions of the test (Table 3; Figure 2). For most of the test the well pumped approximately 105 gpm. Discharge could not be regulated because there was no valve installed in the discharge line. The pumped well could not be used for measurements after the test started due to technical difficulties. The test data and results are attached (Tables 1-3; Figures 1 through 16). The following results are an average from all three wells:

Hydraulic Characteristic	*Average*	*Maximum*	*Minimum*
Transmissivity (ft^2/day)	129	157.7	91.9
Storage Coefficient	.00015	.0001966	.0001162

Conclusions and Recommendations

The aquifer at the Medina WSC well field is under artesian conditions as indicated by the storage coefficient determined from the aquifer test. The aquifer has a low transmissivity. Together, wells 1 and 3 are capable of pumping approximately 160 gpm over an extended time. The pumped well during the test averaged 105 gpm over 12 hours. Records of the WSC show a maximum daily usage for 1997 is approximately 110,000 gallons. If well No. 3 was the only well in operation, it would have to pump a total of 17½ hours in one day to meet the peak demand. Additionally, if this well pumped continuously for 24 hours it would produce roughly 150,000 gallons, which is a 36 percent increase over the present peak demand. If one of the wells were to be inoperable during a peak time, it is likely that the system would not keep up with the demand for water.

After ten hours of pumping, the cone of depression produced by well No. 3 will influence an area up to 1000 feet away. This would be seen in water-levels declines within this 1000 feet radius. For example, after ten hours of pumping from well No. 3, any well 300 feet away will experience a water-level decline of 20 to 30 feet. Wells less than 300 feet away would experience greater water-level declines. Pumping of multiple wells at this site will concentrate the water-level declines. Options suggested by the Medina WSC for additional water include rehabilitation of well No. 2 or a new well on the same site. If three wells are pumped simultaneously on this site, the wells will compete with each other and individual well yields will be reduced.

The aquifer test results indicate that this site is not suitable for additional development. Test transmissivity values are lower than the suggested 1000 ft^2/day for public supply wells. For future growth, it is recommended that another well or well field should be established at another location. Data and results of the test are attached.

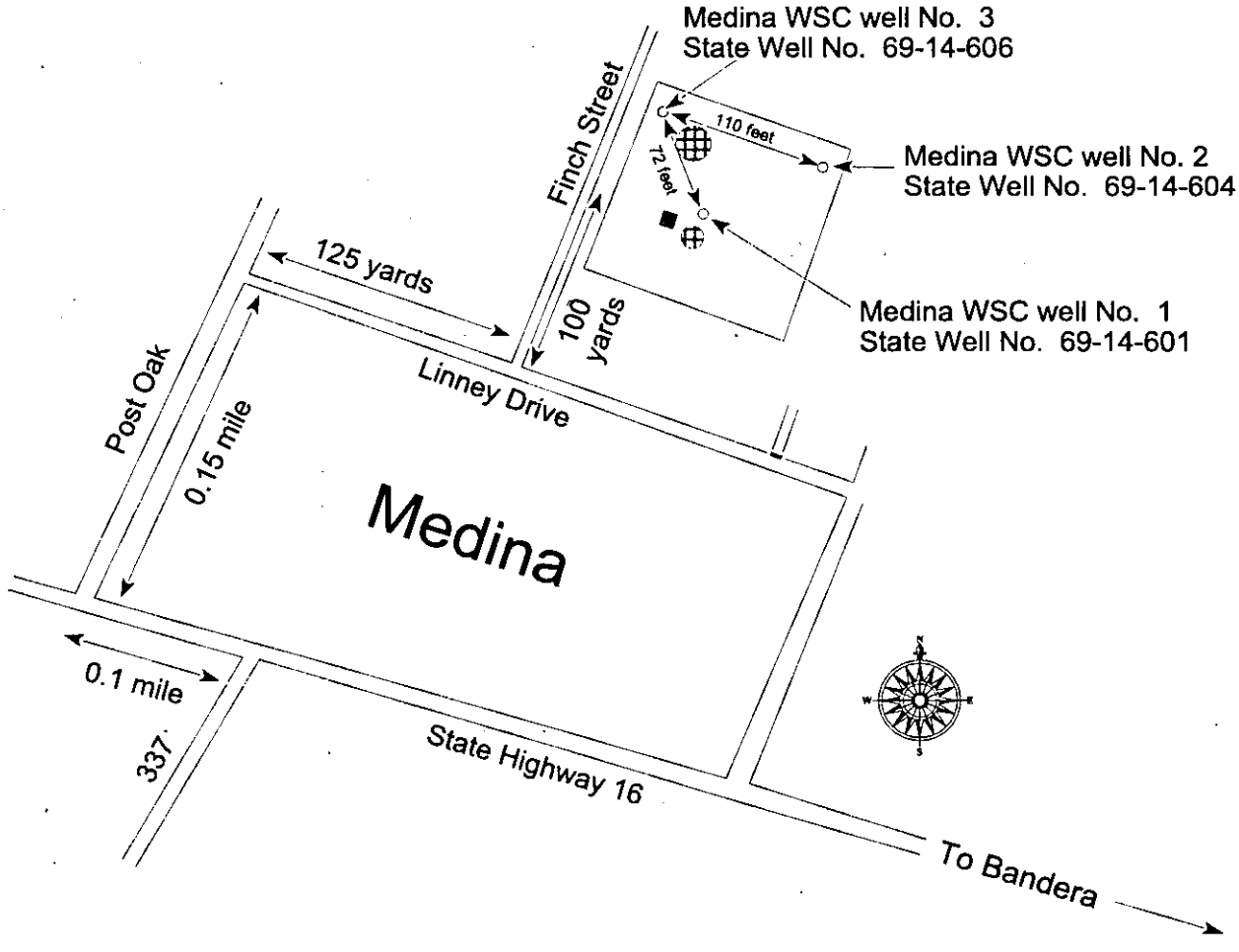

Figure 1. Map showing the location of the Medina WSC well field.

Table 1. Aquifer test data, Medina WSC well No. 1, August 5 – 6, 1997

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
0	161.45				
18	160.10				
36	159.30				
48	158.51				
63	157.82				
78	157.18				
93	156.58				
108	156.05				
123	155.54				
138	155.05				
153	154.64				
168	154.22				
183	153.84				
198	153.48				
213	153.14				
228	152.81				
243	152.53				
258	152.21				
273	151.94				
288	151.65				
303	151.43				
318	151.15				
333	150.92				
349	150.76	1	0.16		Pump on 348
351.5	150.91	3.5	0.01		
354	151.77	6	-0.85		
356	152.71	8	-1.79		
358	153.79	10	-2.87		
361.5	155.14	13.5	-4.22		
363	156.6	15	-5.68		
365	157.91	17	-6.99		
367	159.16	19	-8.24		
371	161.52	23	-10.60		
375	163.75	27	-12.83		
381	166.85	33	-15.93		
386	169.06	38	-18.14		
391	171.05	43	-20.13		
395	172.43	47	-21.51		
401	174.3	53	-23.38		
406	175.71	58	-24.79		

Table 1. Aquifer test data, Medina WSC well No. 1, August 5 – 6, 1997

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
411	176.97	63	-26.05		
413	177.44	65	-26.52		
423	179.54	75	-28.62		
433	181.3	85	-30.38		
443	182.85	95	-31.93		
453	184.13	105	-33.21		
468	185.78	120	-34.86		
483	187.13	135	-36.21		
498	188.31	150	-37.39		
513	189.47	165	-38.55		
528	190.51	180	-39.59		
543	191.31	195	-40.39		
558	192.09	210	-41.17		
573	192.81	225	-41.89		
588	193.44	240	-42.52		
608	194.22	260	-43.30		
628	194.92	280	-44.00		
648	195.56	300	-44.64		
678	196.4	330	-45.48		
708	197.11	360	-46.19		
768	198.32	420	-47.40		
828	199.32	480	-48.40		
888	200.13	540	-49.21		
949	200.82	601	-49.90		
1008	201.41	660	-50.49		
1068	201.86	720	-50.94		
1070	201.85	722	-50.93	1	Pump off at 1069
1071	201.84	723	-50.92	2	
1072	201.84	724	-50.92	3	
1073	201.61	725	-50.69	4	
1074	201.37	726	-50.45	5	
1075	201.04	727	-50.12	6	
1076	200.55	728	-49.63	7	
1077	200.02	729	-49.10	8	
1078	199.43	730	-48.51	9	
1080	198.12	732	-47.20	11	
1082	196.73	734	-45.81	13	
1084	195.28	736	-44.36	15	
1086	193.86	738	-42.94	17	
1088	192.47	740	-41.55	19	

Table 1. Aquifer test data, Medina WSC well No. 1, August 5 – 6, 1997

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
1093	189.21	745	-38.29	24	
1098	186.35	750	-35.43	29	
1103	183.9	755	-32.98	34	
1108	181.72	760	-30.80	39	
1113	179.85	765	-28.93	44	
1118	178.16	770	-27.24	49	
1123	176.66	775	-25.74	54	
1128	175.31	780	-24.39	59	
1138	172.97	790	-22.05	69	
1151	170.53	803	-19.61	82	
1158	169.36	810	-18.44	89	
1168	167.93	820	-17.01	99	
1178	166.67	830	-15.75	109	
1188	165.53	840	-14.61	119	
1203	164.06	855	-13.14	134	
1218	162.59	870	-11.67	149	
1233	161.64	885	-10.72	164	
1248	160.65	900	-9.73	179	
1263	159.75	915	-8.83	194	
1278	158.94	930	-8.02	209	
1293	158.21	945	-7.29	224	
1308	157.52	960	-6.60	239	
1328	156.72	980	-5.80	259	
1348	155.99	1000	-5.07	279	
1368	155.32	1020	-4.40	299	
1398	154.42	1050	-3.50	329	
1428	153.64	1080	-2.72	359	
1488	152.29	1140	-1.37	419	
1548	151.2	1200	-0.28	479	
1608	150.28	1260	0.64	539	
1668	149.49	1320	1.43	599	
1728	148.79	1380	2.13	659	
1788	148.14	1440	2.78	719	

Table 2. Aquifer test data, Medina WSC well No. 2, August 5 – 6, 1997.

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
0	113.1				swl to establish trend
15	112.1				
30	111.13				
45	110.4				
60	109.63				
75	108.96				
90	108.36				
105	107.77				
120	107.24				
135	106.75				
150	106.3				
165	105.86				
180	105.46				
195	105.07				
210	104.7				
225	104.34				
240	104.01				
255	103.71				
270	103.4				
285	103.13				
300	102.85				
315	102.6				
332	102.23	2	0.37		Pump on @330
334.5	102.51	4.5	0.09		
337	102.99	7	-0.39		
339	103.61	9	-1.01		
341	104.41	11	-1.81		
344	105.59	14	-2.99		
346	106.78	16	-4.18		
348	107.87	18	-5.27		
350	108.3	20	-5.7		
355	111.55	25	-8.95		
360	114.2	30	-11.6		
365	116.49	35	-13.89		
370	118.77	40	-16.17		
375	120.86	45	-18.26		
380	122.56	50	-19.96		
385	124.38	55	-21.78		
390	125.91	60	-23.31		

Table 2. Aquifer test data, Medina WSC well No. 2, August 5 – 6, 1997.

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
400	128.51	70	-25.91		
410	130.83	80	-28.23		
420	132.78	90	-30.18		
430	134.54	100	-31.94		
440	136.08	110	-33.48		
450	137.35	120	-34.75		
465	139.05	135	-36.45		
480	140.6	150	-38		
495	142.4	165	-39.8		
510	143.3	180	-40.7		
525	144.66	195	-42.06		
540	145.85	210	-43.25		
557	146.54	227	-43.94		
574	147.49	244	-44.89		
592	148.39	262	-45.79		
612	149.34	282	-46.74		
632	150.5	302	-47.9		
662	151.11	332	-48.51		
692	152.1	362	-49.5		
752	153.81	422	-51.21		
812	155.41	482	-52.81		
872	156.55	542	-53.95		
932	157.52	602	-54.92		
992	158.39	662	-55.79		
1050	159.25	720	-56.65		
1052	159.15	722	-56.55	1	Pump off @1051
1053	159	723	-56.4	2	
1054	158.9	724	-56.3	3	
1055	158.8	725	-56.2	4	
1056	158.6	726	-56	5	
1059	157.9	729	-55.3	8	
1060	157.6	730	-55	9	
1061	157.4	731	-54.8	10	
1063	156.25	733	-53.65	12	
1065	155.4	735	-52.8	14	
1067	154.8	737	-52.2	16	
1069	152.6	739	-50	18	
1071	151.35	741	-48.75	20	
1076	148.05	746	-45.45	25	
1081	145.6	751	-43	30	

Table 2. Aquifer test data, Medina WSC well No. 2, August 5 – 6, 1997.

Elapsed Time (minutes)	Water Level Feet Below M.P.	Time Pump on (minutes)	Drawdown (feet)	Time Pump off (minutes)	Remarks
1086	143	756	-40.4	35	
1091	140.6	761	-38	40	
1096	138.3	766	-35.7	45	
1101	136.8	771	-34.2	50	
1106	135.15	776	-32.55	55	
1111	133.5	781	-30.9	60	
1120	131.45	790	-28.85	69	
1130	129	800	-26.4	79	
1140	127.35	810	-24.75	89	
1150	125.25	820	-22.65	99	
1160	123.7	830	-21.1	109	
1170	122.4	840	-19.8	119	
1185	120.53	855	-17.93	134	
1200	118.9	870	-16.3	149	
1215	117.55	885	-14.95	164	
1230	116.25	900	-13.65	179	
1245	115.15	915	-12.55	194	
1260	114.08	930	-11.48	209	
1275	113.25	945	-10.65	224	
1290	112.32	960	-9.72	239	
1310	111.38	980	-8.78	259	
1330	110.5	1000	-7.9	279	
1350	109.5	1020	-6.9	299	
1380	108.42	1050	-5.82	329	
1410	107.47	1080	-4.87	359	
1470	105.72	1140	-3.12	419	
1530	104.35	1200	-1.75	479	
1590	103.12	1260	-0.52	539	
1650	102.18	1320	0.42	599	
1710	101.25	1380	1.35	659	
1770	100.5	1440	2.1	719	

Table 3. Pumping Rates

Elapsed Pumping Time (minutes)	Flowmeter Discharge (gpm)
1	171
4	150
7	138
8	138
9	137
10	136
12	132
14	128
17	126
23	123
30	122
35	116
40	117
52	113
60	115
78	111
90	110
127	111
185	110
214	107
228	108
247	105
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304	106
335	105
365	104
427	102
487	104
545	105
604	105
663	104
719	105

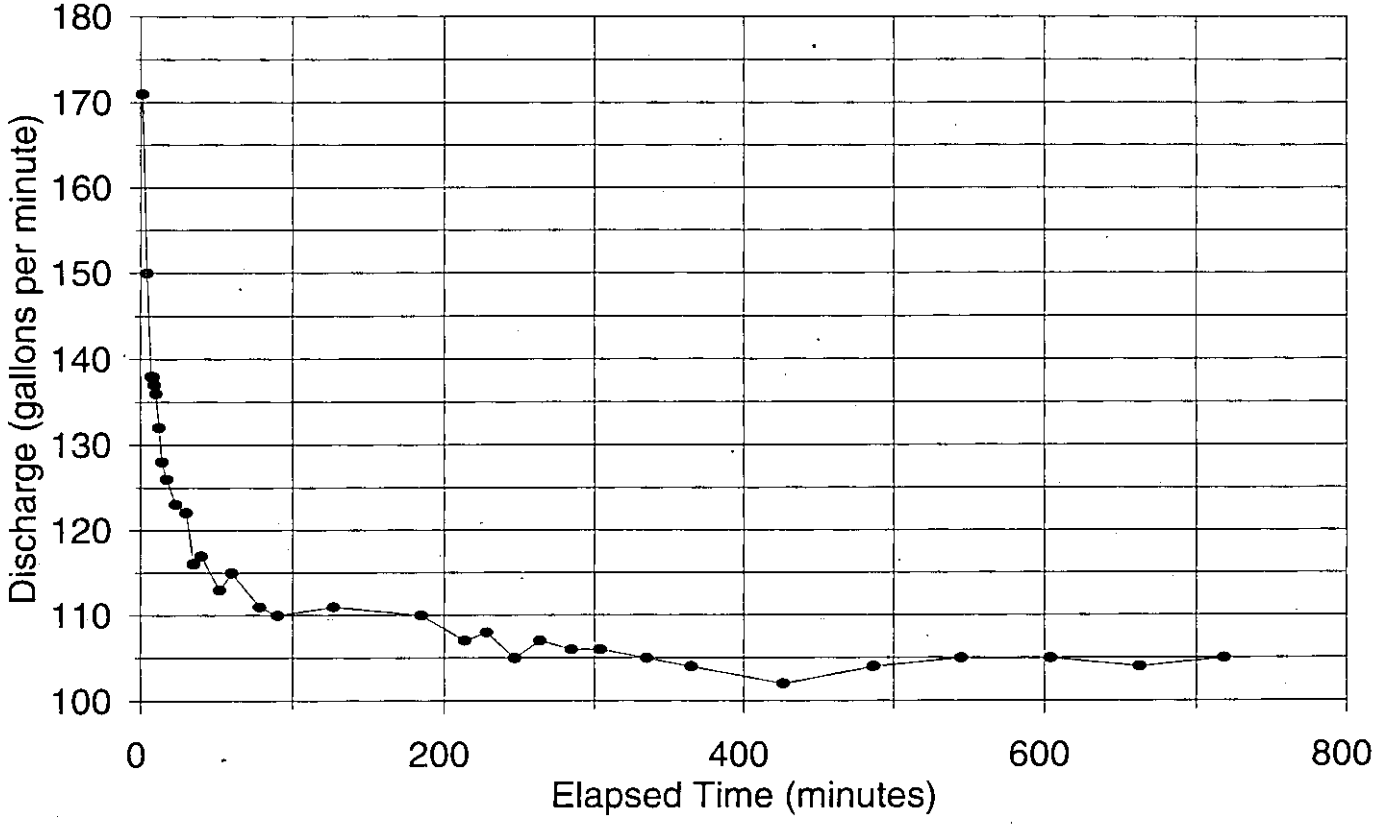


Figure 2. Pumped well discharge of Medina WSC well No. 3.

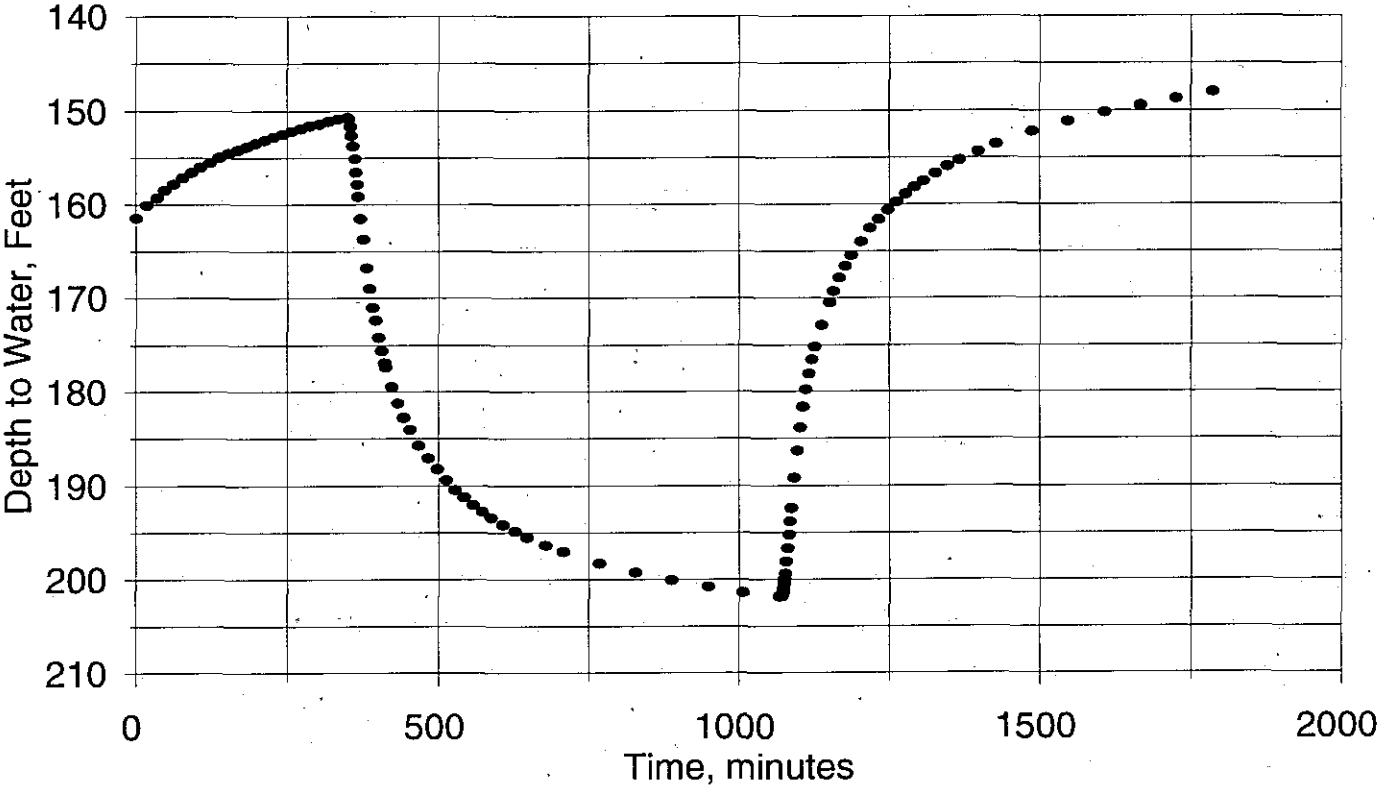


Figure 3. Water level measurements, Medina WSC well No. 1.

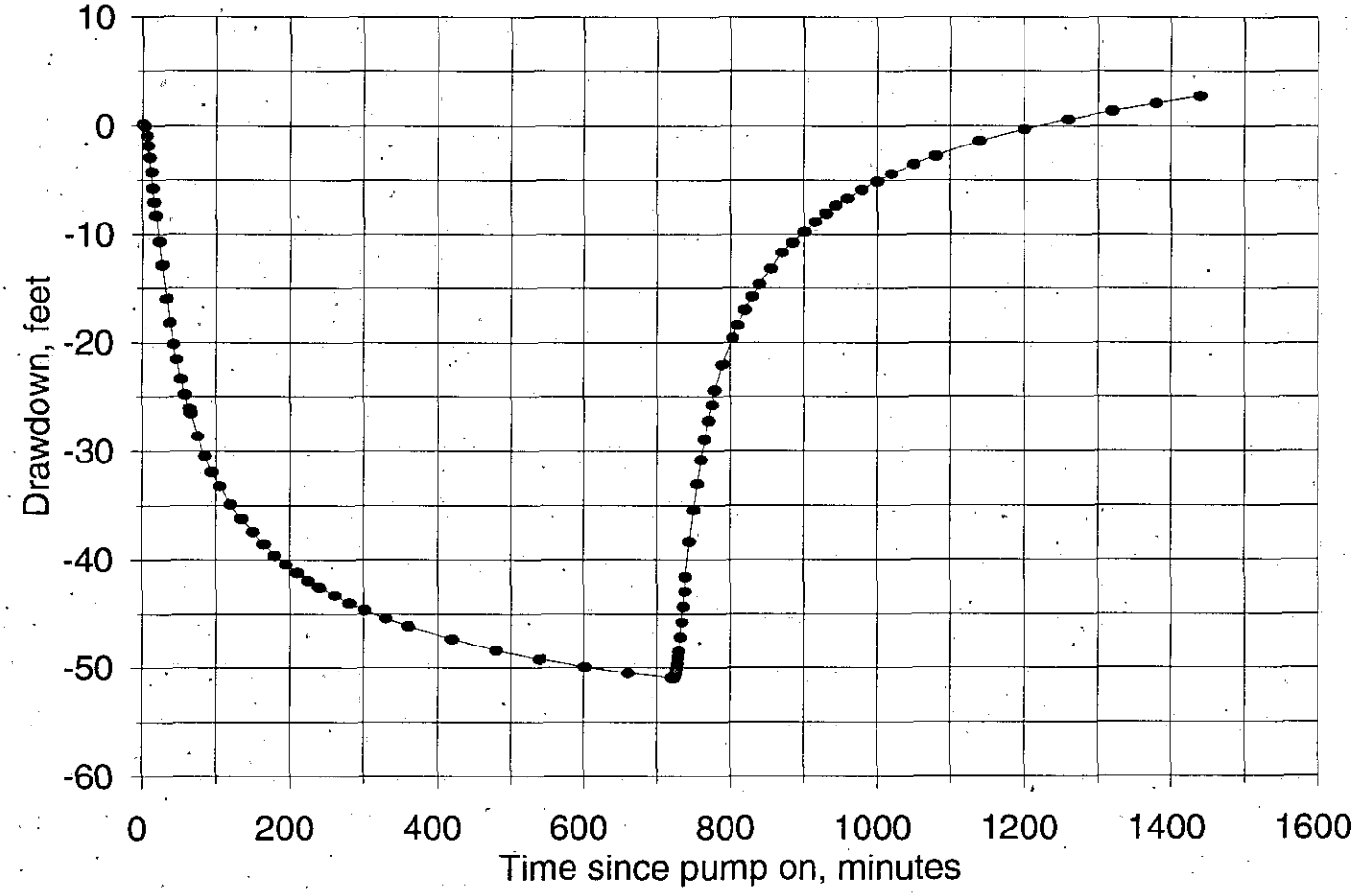


Figure 4. Drawdown measurements, Medina WSC well No. 1.

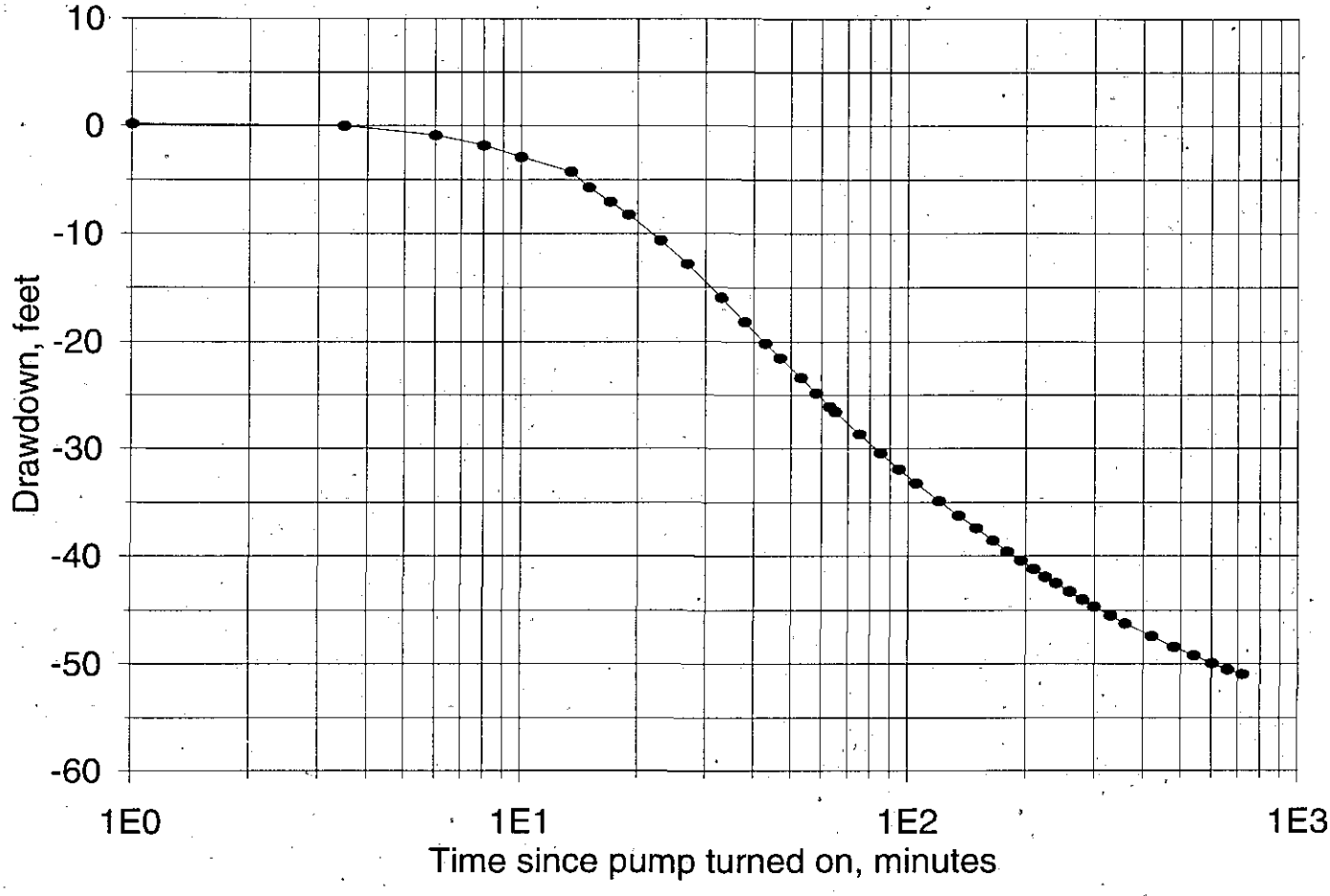


Figure 5. Drawdown measurements for Medina WSC well No. 1, minutes since pump turned on.

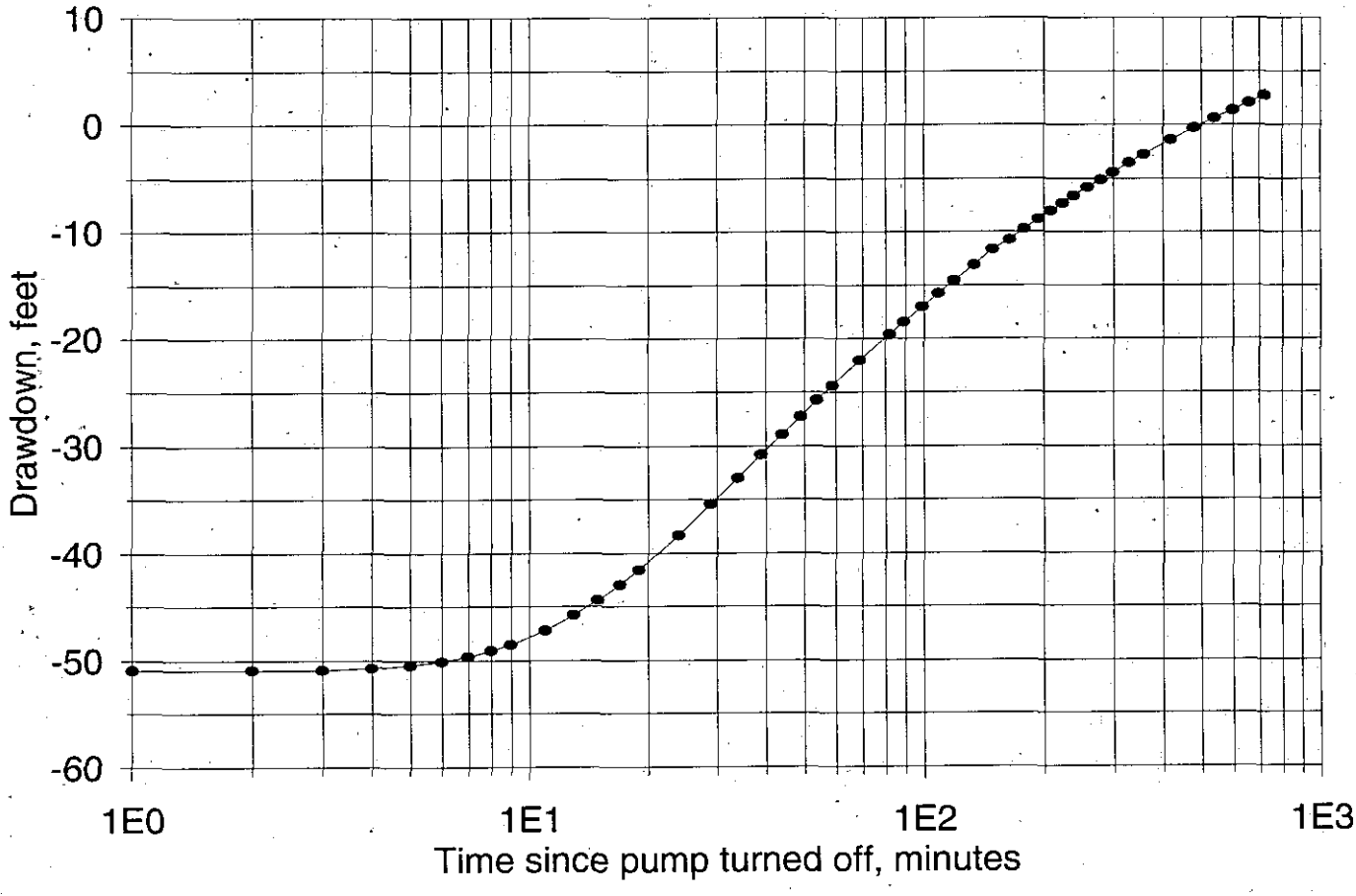


Figure 6. Recovery measurements for Medina WSC well No. 1, minutes since pump turned off.

Figure 7. Theis plot for Medina WSC well No. 1.

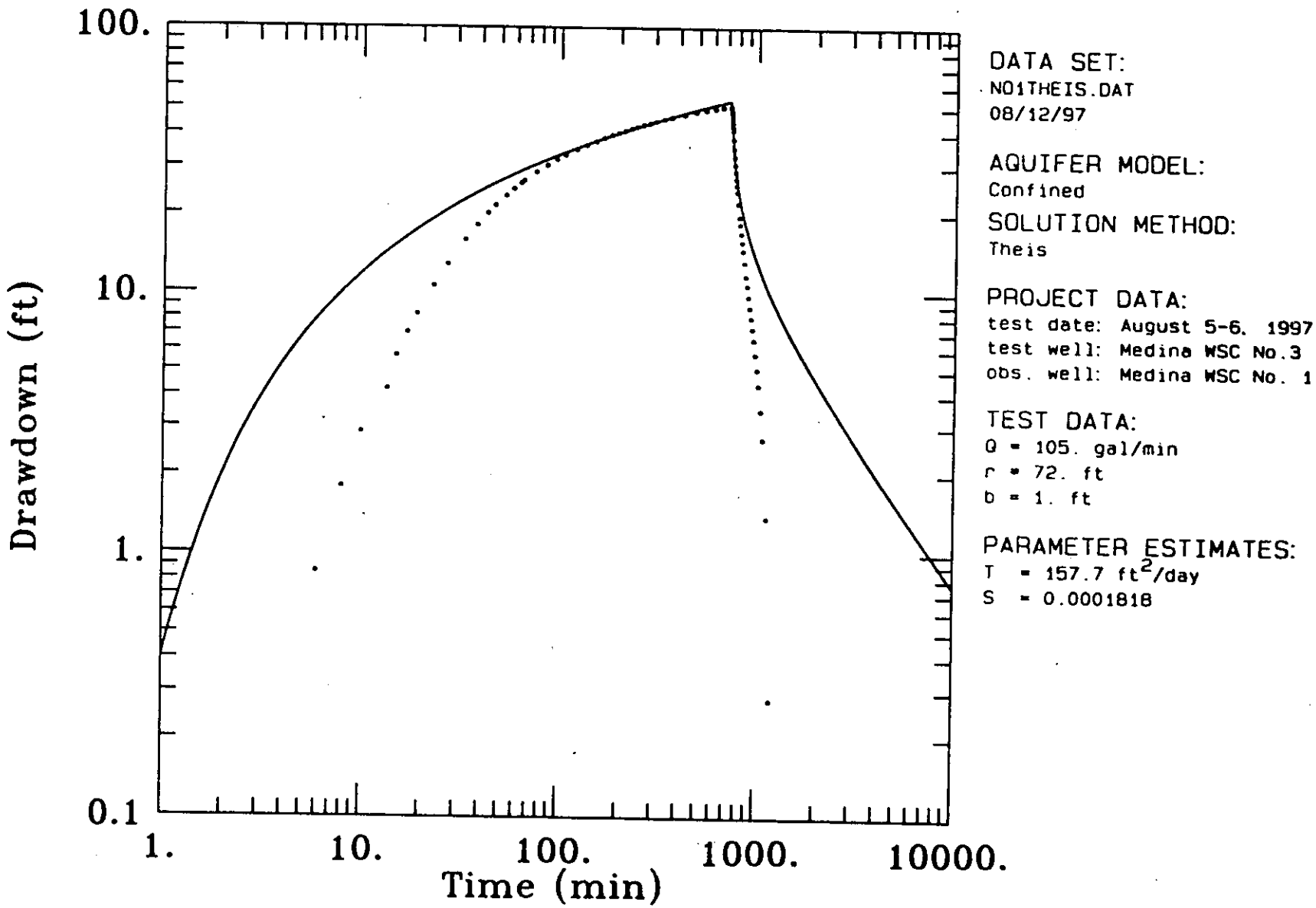


Figure 8. Cooper-Jacob plot for Medina WSC well No. 1.

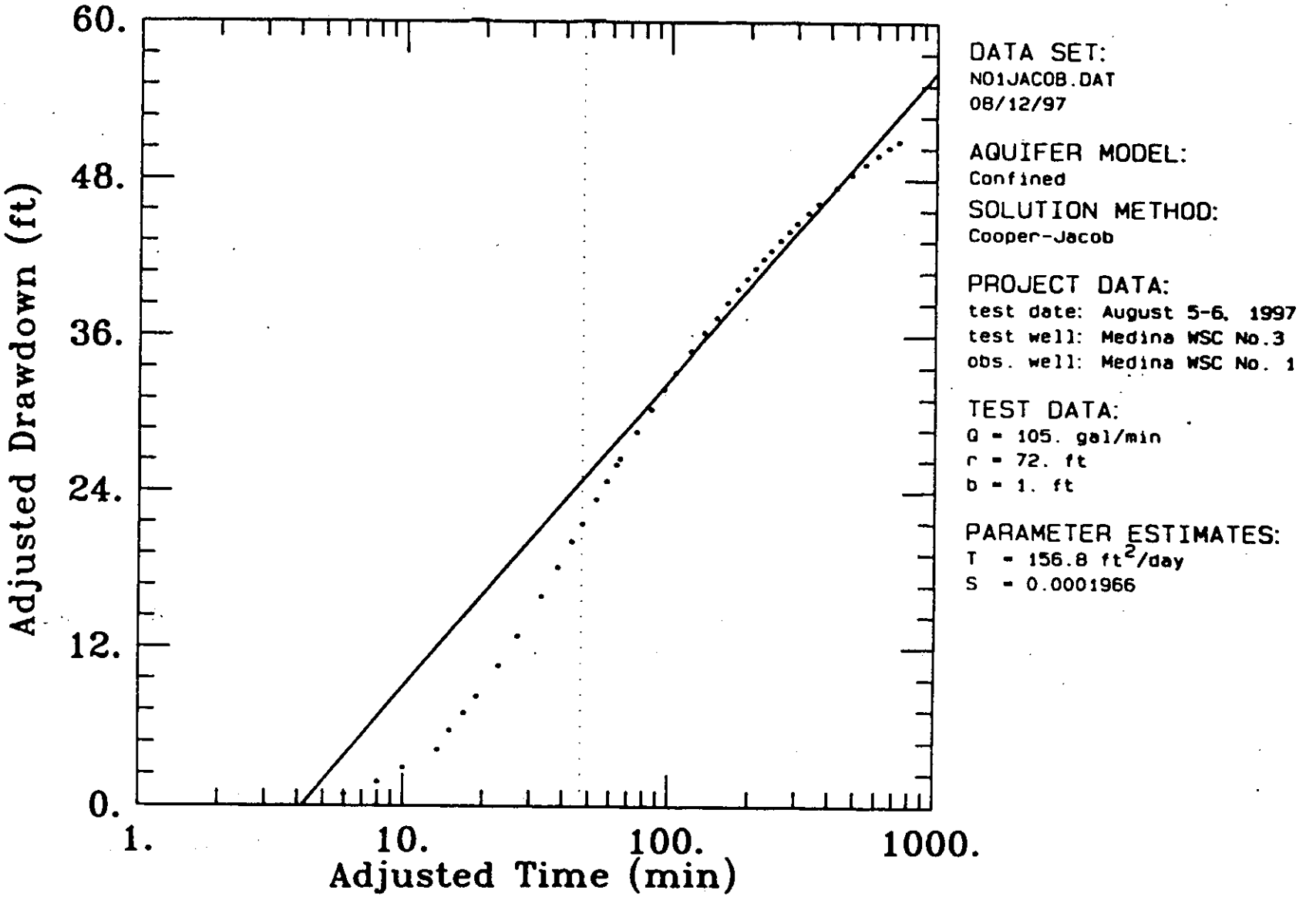
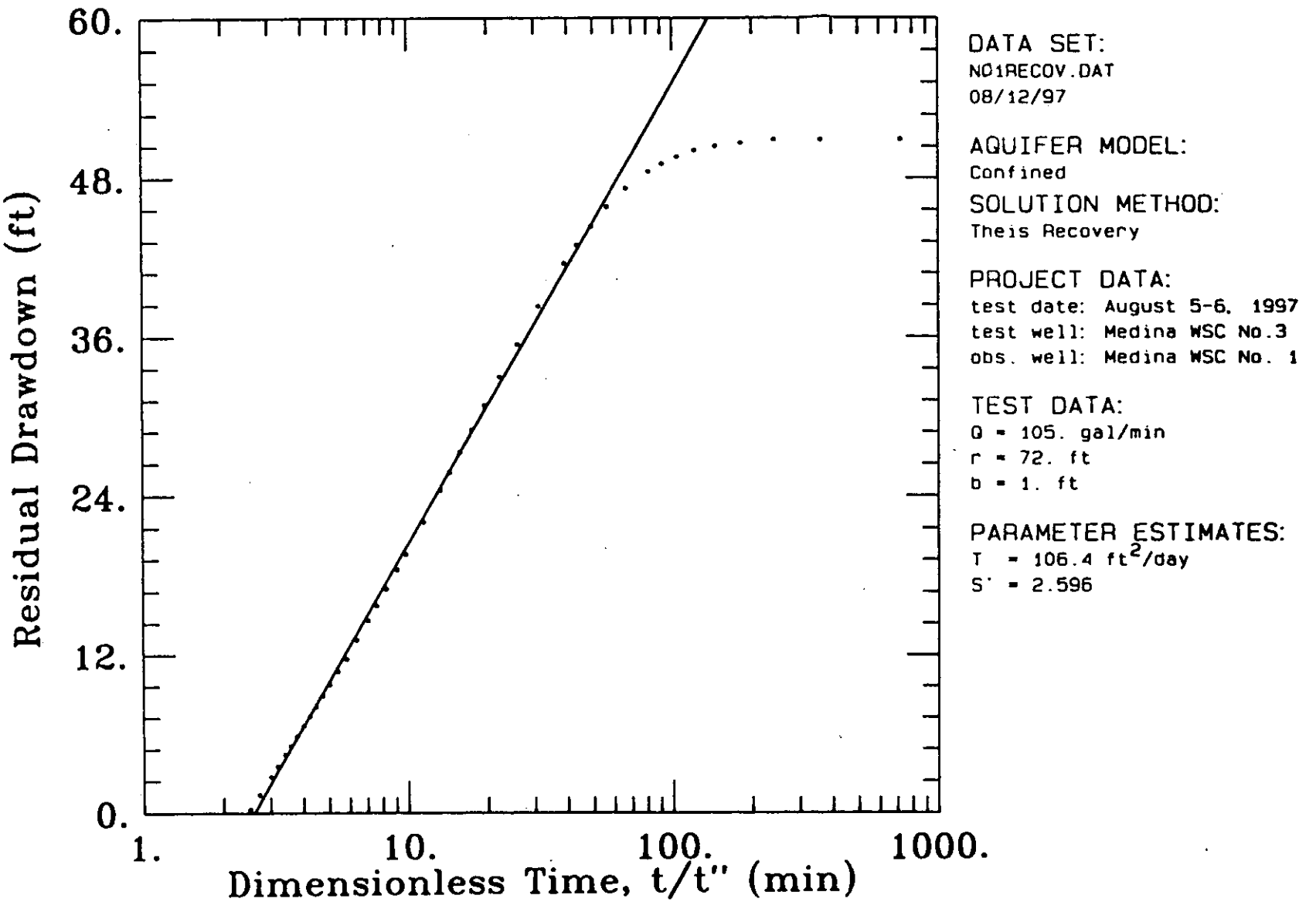


Figure 9. Theis recovery plot for Medina WSC well No. 1.



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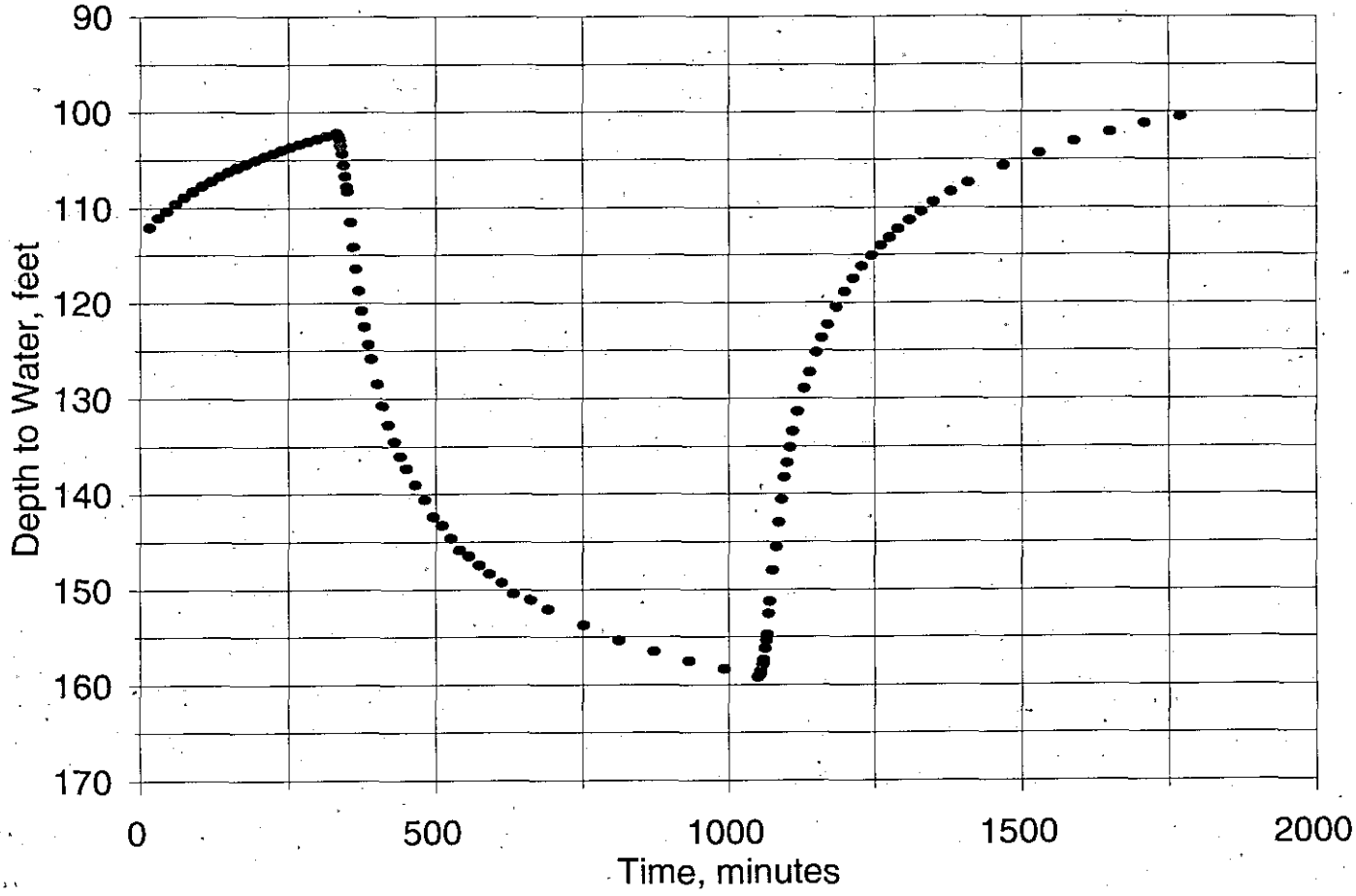

Figure 10. Water level measurements, Medina WSC well No. 2.

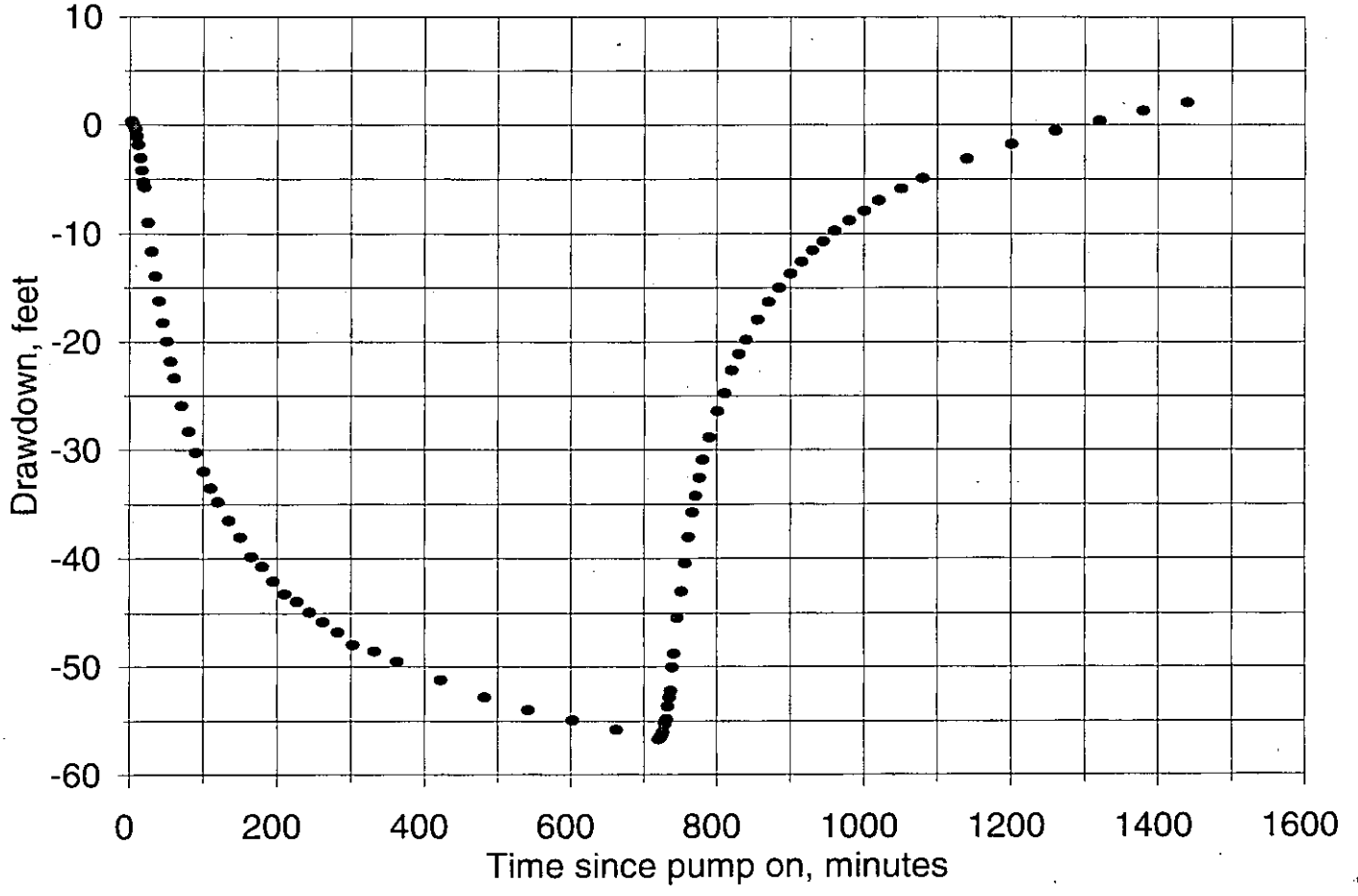

Figure 11. Drawdown measurements, Medina WSC well No. 2.

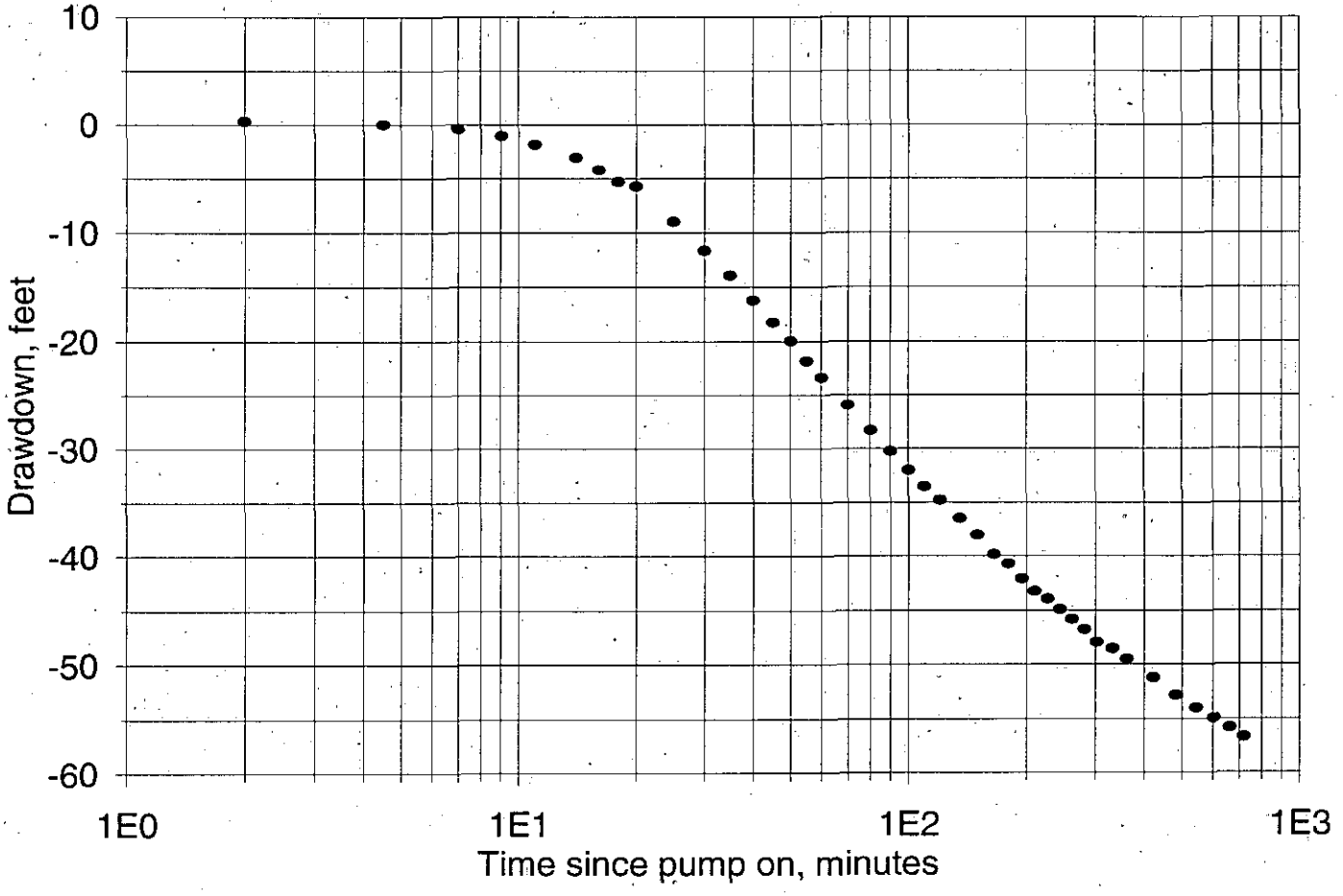

Figure 12. Drawdown measurements for Medina WSC well No. 2, minutes since pump turned on.

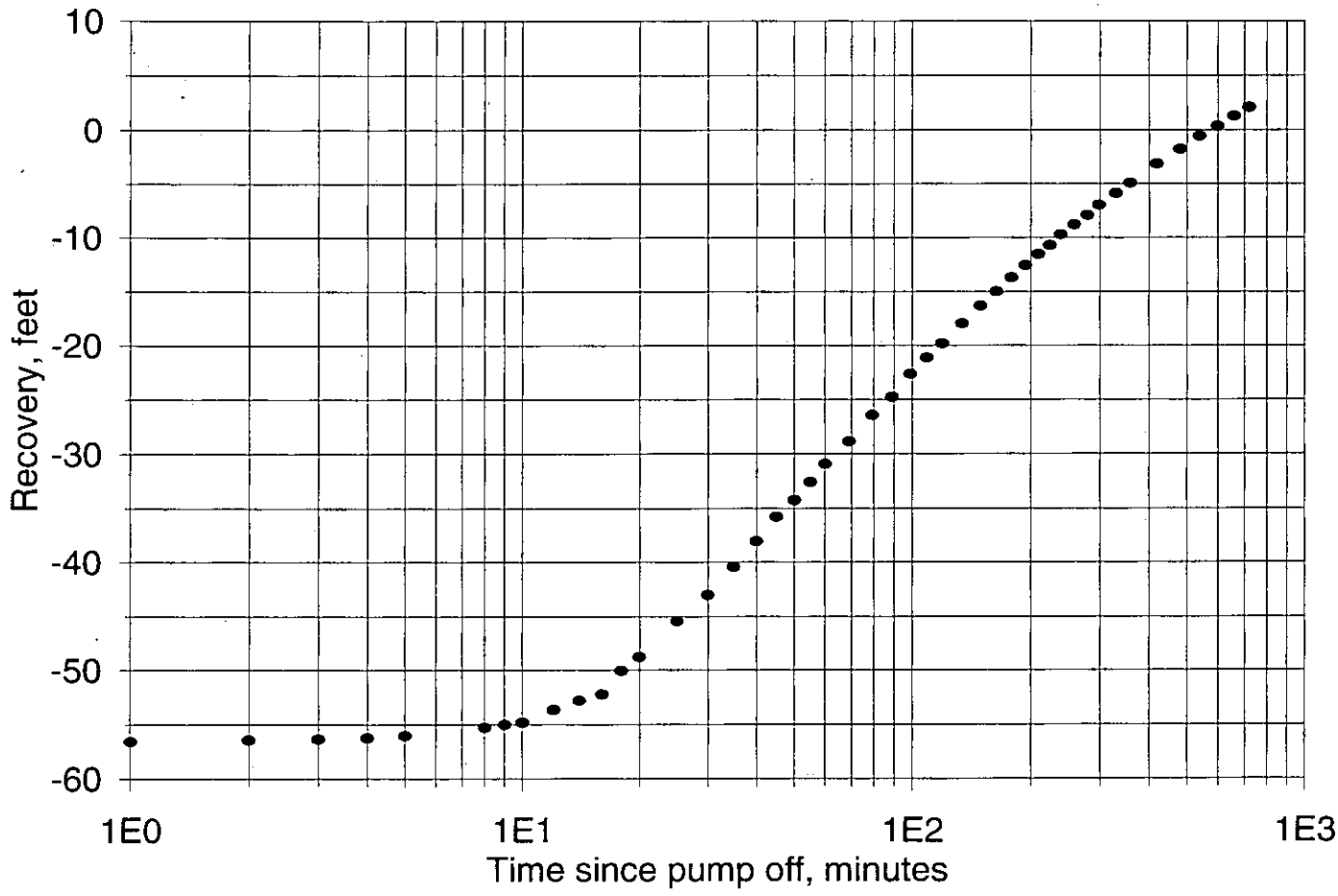

Figure 13. Recovery measurements for Medina WSC well No. 2, minutes since pump turned off.

Figure 14. Theis plot for Medina WSC well No. 2.

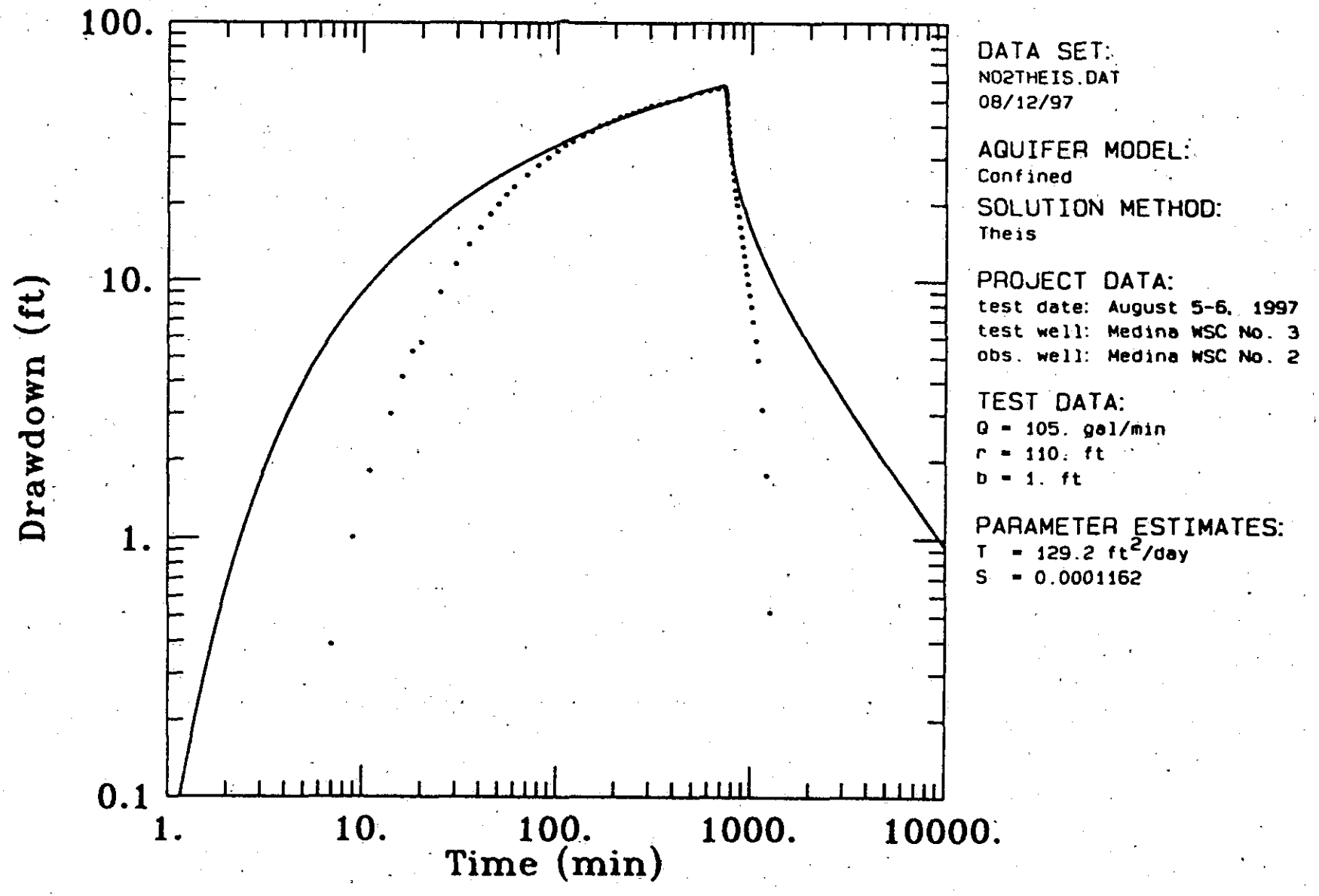

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Figure 15. Cooper-Jacob plot for Medina WSC well No. 2.

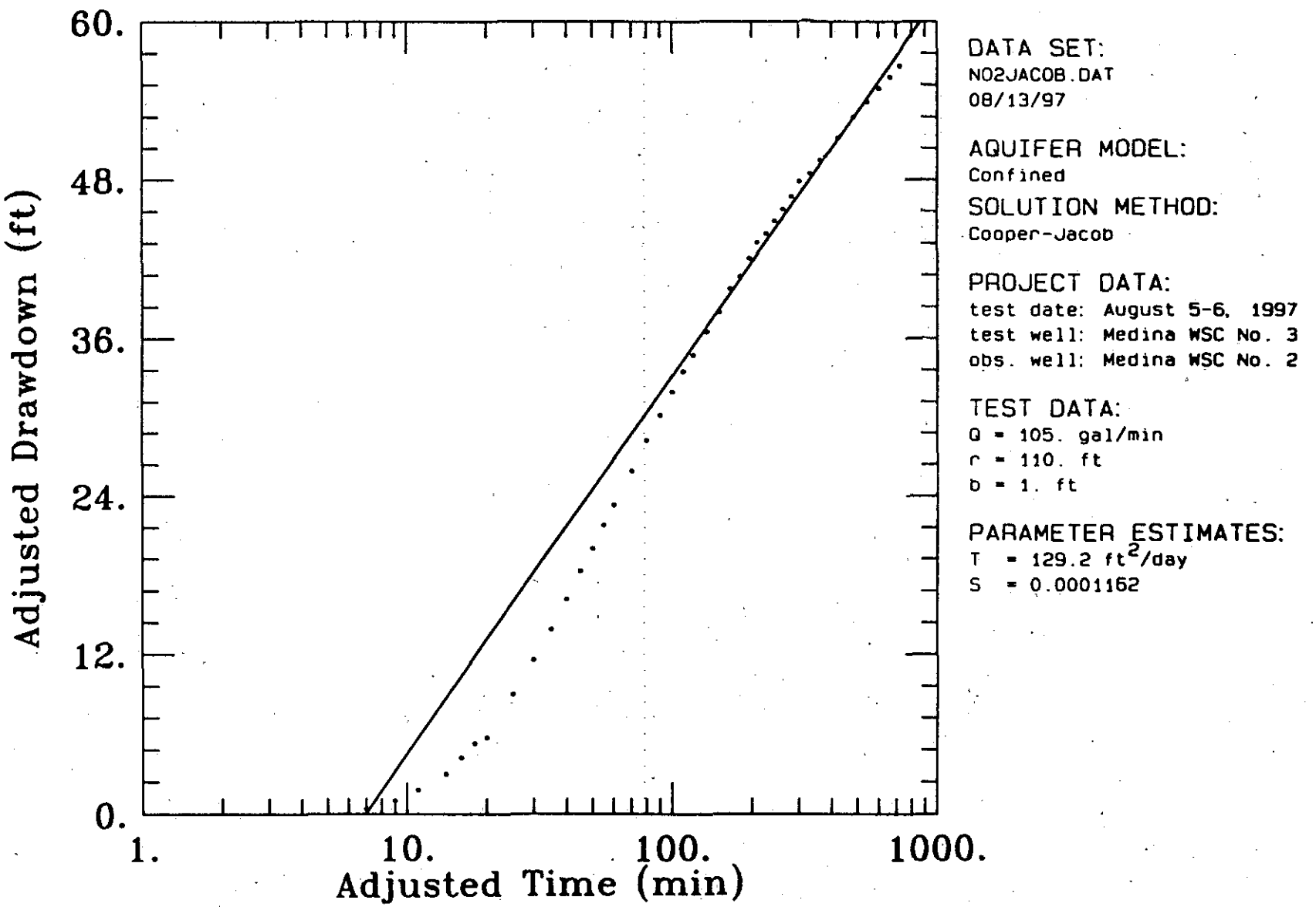

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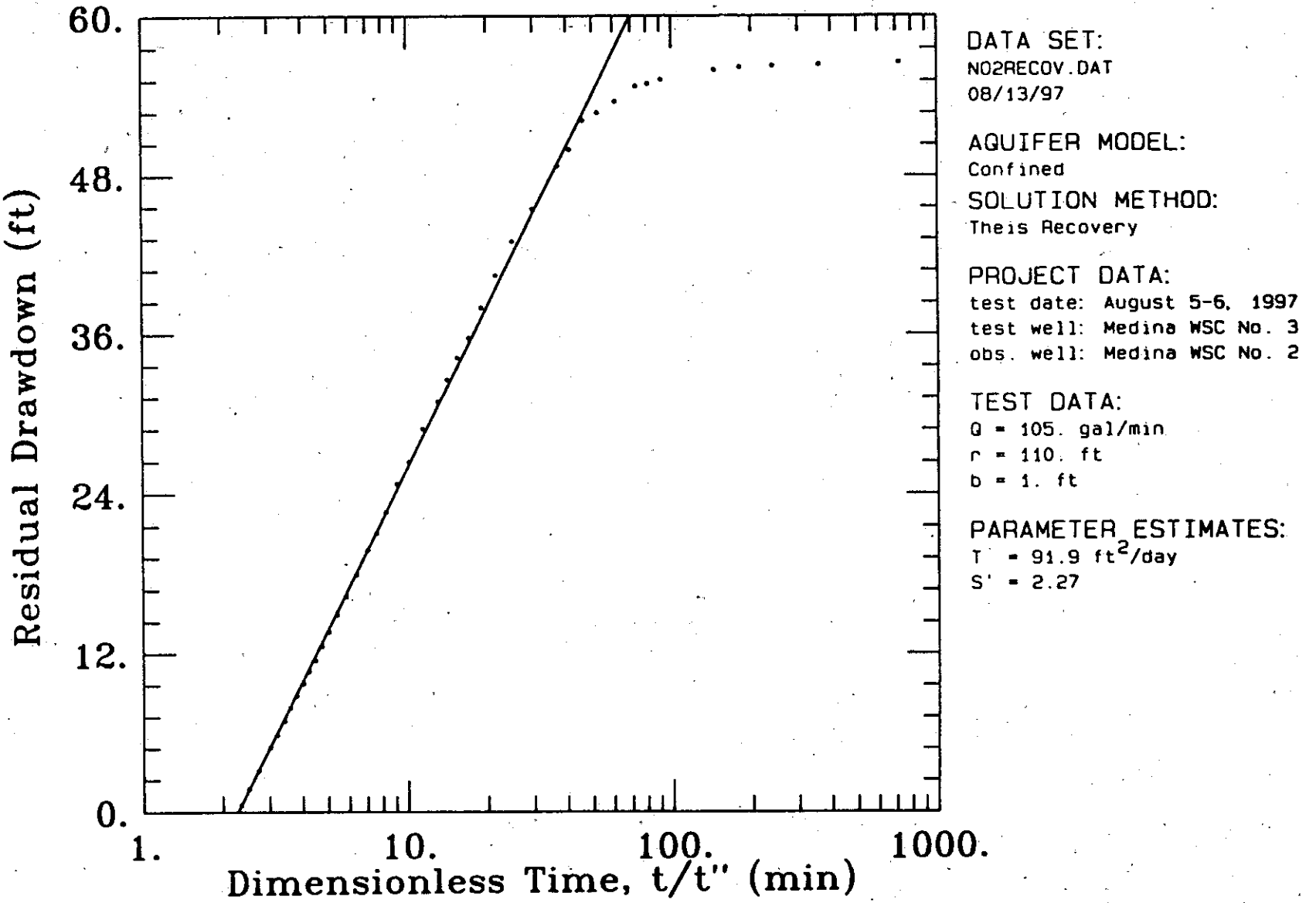
Figure 16. Theis recovery plot for Medina WSC well No. 2.



AQTESOLV