AQUIFER TESTING CALCULATION BRIEF
April & May, 2006 Aquifer Tests

Exxon RAS #2-8077
14258 Jarrettsville Pike
Phoenix Maryland

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Introduction

In order to more fully characterize subsurface conditions in support of site characterization and potential remedial system design, aquifer testing was conducted at the site in two locations. The first aquifer test, conducted in the area surrounding monitoring well MW-77B was conducted on April 13 and 14, 2006. The second aquifer test, conducted in the area surrounding monitoring well MW-112 was conducted between May 10 and May 12, 2006. MW-77B is located in the northeastern section of the site, while MW-112 is located in the southwestern section of the site. The aquifer testing consisted of both step-drawdown and constant rate pump testing of the site's bedrock and unconsolidated overburden aquifers. The step-drawdown testing was conducted in order to evaluate basic extraction well performance (i.e. well capacity) prior to the performance of the constant-rate pump testing. In all aquifer tests, in-well pressure transducers were installed in the extraction wells and in surrounding monitoring wells in order to document groundwater elevation changes over the course of the tests. Additionally, manual groundwater gauging was conducted on a regular basis using an electronic interface probe so that adjustments could be made to the aquifer tests in real time.

Aquifer Testing Methodology

<u>Step Drawdown Test</u>
Step drawdown testing was only conducted in MW-112, since MW-77B had previously been utilized extensively for interim remedial pumping purposes, and consequently the practical production rates of this monitoring well were fairly well known. Based on this history, the anticipated extraction rate to be used in the constant rate pumping test at MW-77B was approximately 10 gallons per minute (gpm).

The step-drawdown test in MW-112 was conducted on May 10, 2006. MW-112 is a 6-inch diameter groundwater monitoring well, installed to a total depth of approximately 48 feet below grade with a screened interval from 15 to 48 feet below grade. Depth to water at the MW-112 location at the time of the aquifer testing was approximately 30 feet below grade, while depth to bedrock at that location is approximately 20 feet below grade. Groundwater extraction was achieved using a Grundfos Redi-Flo4® electric submersible pump, and extraction rates tested were 2.6, 5.0, 6.7 and 9.1 gpm. Each stage was tested for approximately 3 hours. Based on the drawdown characteristics in MW-112 at the different extraction rates, a sustainable extraction rate of approximately 7 gpm was selected for use in the subsequent constant-rate aquifer test at this location.

<u>MW-77B Constant Rate Test</u>
MW-77B is a 6-inch diameter groundwater monitoring well, installed to a total depth of approximately 43 feet below grade with a screened interval from 33 to 43 feet below grade. Depth to water at the MW-77B location at the time of the aquifer testing was approximately 20 feet below grade, while depth to bedrock at that location is approximately 15 feet below grade. Utilizing a Grundfos Redi-Flo4® electric submersible pump, groundwater extraction was initiated at approximately 4:00 pm, April 13, 2006 and continued for approximately 24 hours at an average extraction rate of 10.47 gpm.

<u>MW-112 Constant Rate Test</u>
Utilizing a Grundfos Redi-Flo4® electric submersible pump, groundwater extraction was initiated at approximately 8:00 am, May 11, 2006 and continued for approximately 33 hours at an average extraction rate of 6.78 gpm.

Aquifer Testing Results

MW-77B Constant Rate Pump Test

Groundwater extraction at MW-77B resulted in measurable groundwater drawdown in six of the surrounding monitoring wells (MW-61A, MW-77A, MW-77R, MW-80B, MW-81 and MW-83R) as summarized in Table 1, Attachment I. Measured drawdown ranged in magnitude from 0.07 feet (MW-61A, located approximately 185 feet from the extraction well) to 2.50 feet (MW-77R, located approximately 14 feet from the extraction well). While complete drawdown equilibrium was not quite reached over the course of the 24-hour aquifer test (Figure 1, Attachment II), the drawdown vs. time curves for most of the monitored wells were well into their asymptotes by the time the aquifer test was concluded. For example, drawdown rates for MW-77A, MW-80B and MW-83R were approximately 0.02 feet per hour or less at the end of the test. For MW-83R, which had the lowest total drawdown of these three wells, this represents a drawdown rate of change of approximately 2.5% per hour. For MW-80B, the drawdown rate of change at the end of the test was approximately 1.1%. Groundwater recharge (negative drawdown, or water table elevation increase) was noted in monitoring wells MW-48A, MW-48B, MW-61B, MW-76P MW-82, MW-82R, MW-89 and MW-106, ranging in magnitude from 0.02 feet (MW-48A located approximately 268 feet from the extraction well) to 1.58 feet (MW-48B, located approximately 273 feet from the extraction well, see Figure 2, Attachment II). The recharge noted in these wells may be due to water table rebound following the cessation of groundwater extraction for remediation purposes in monitoring wells throughout this area. Remediation-based pumping activities were ceased approximately 24 hours prior to the initiation of the aquifer testing, and the water table was allowed to stabilize. However, some minor residual water table equilibration may still have been occurring during the course of the aquifer test. Absent the recharge in MW-48B, the average recharge in these wells was 0.10 feet. This slight recharge was not expected to significantly affect the aquifer testing results and therefore no recharge corrections were made to the test data. The recharge in MW-48B was also not considered to have a negative influence on the test given its distance from the extraction well (273 feet).

Drawdown in MW-77A was of lower magnitude than in MW-77R despite MW-77A's being approximately 10 feet closer to the extraction well. However, the construction of MW-77A is such that only 3 feet of its screened interval penetrates the top of the saturated bedrock aquifer. MW-77R has 15 feet of screen in the saturated bedrock, and the extraction well's screen covers 28 feet of saturated bedrock. The apparent drawdown vs. distance anomaly between MW-77A and MW-77R is likely due to MW-77A's limited bedrock representation. Consequently, data from MW-77A was not used in the aquifer test data reduction. Conversely, the drawdown in MW-80B was high relative to its distance from MW-77B. This well is screened entirely within the unconsolidated overburden and as such its drawdown characteristics may also not correlate well to the effects of the extraction well. Some of the data from MW-80B, however, was used in the aquifer test analyses as discussed in further detail below.

Hydraulic conductivity (K) was calculated both "manually" utilizing the Cooper-Jacob "straight-line" distance-drawdown method and via Waterloo Hydrogeologic's Aquifer Test for Windows software, utilizing Cooper Jacob distance-drawdown and Cooper Jacob time-distance drawdown methods. As pointed out above, the drawdown characteristics of MW-80B were anomalous relative to its distance from the extraction well MW-77B. However, in light of the slight regional water table elevation increase in surrounding wells, the water table decrease in MW-80B was still considered to be linked to groundwater extraction at MW-77B. However, due to the anomalous drawdown, this well's data were only used in the time-drawdown evaluation and not in the distance-drawdown evaluations.

The resulting K values from these evaluations were as follow:

Method	Wells Used	K (ft/day)
Cooper Jacob "Manual" Straight Line	MW-61A, MW-77R, MW-81, MW-83R	15.8
Aquifer Test for Windows Cooper Jacob Distance Drawdown	MW-61A, MW-77R, MW-81, MW-83R	15.5
Aquifer Test for Windows Cooper Jacob Time-Distance Drawdown	MW-77R, MW-80B, MW-83R	13.6

The two distance drawdown evaluations yielded essentially the same value, while the time-distance drawdown yielded a K value approximately 2 ft/day lower. Based on these data, an approximate K value for this area is estimated at 14.6 ft/day. The data graphs from the "manual" straight-line evaluation along with the software output from Aquifer Test for Windows is presented in Attachment III.

MW-112 Constant Rate Pump Test
Groundwater extraction at MW-112 resulted in measurable groundwater drawdown in nine of the surrounding monitoring wells (MW-60, MW-70, MW-113, MW-120, MW-122, MW-123, MW-124, MW-140A and MW-140B) as summarized in Table 2, Attachment I. Measured uncorrected drawdown ranged in magnitude from 0.02 feet (MW-140B, located approximately 207 feet from the extraction well) to 4.78 feet (MW-124, located approximately 40 feet from the extraction well). Complete drawdown equilibrium was not reached in all monitoring wells over the course of the 32-hour aquifer test, particularly notable in monitoring wells MW-120, MW-123 and MW-124 (see Figure 3, Attachment II, showing drawdowns normalized to a starting depth to water of 20 feet below grade). Groundwater recharge (negative drawdown, or water table elevation increase) was noted in fourteen monitoring wells MW-40, MW-55, MW-63, MW-64, MW-67, MW-71, MW-72, MW-102, MW-111, MW-116, MW-117, MW-118, MW-119 and MW-126, ranging in magnitude from 0.05 feet (MW-102 located approximately 27 feet from the extraction well) to 0.89 feet (MW-72, located approximately 52 feet from the extraction well, see Figure 4, Attachment II). The average recharge over the course of the test in the fourteen monitoring wells listed above was 0.40 feet. In the area surrounding MW-112, remediation-based pumping activities were ceased approximately 36 hours prior to the initiation of the aquifer testing, and the water table was allowed to stabilize. However, in addition to the potential for residual remediation-based pumping rebound in this area as discussed above for MW-77B, the recharge measured during the MW-112 constant rate pump test was also associated with a precipitation event. Consequently, the distance-drawdown evaluations were calculated using a correction factor of 0.40 feet for the final drawdown (measured drawdown - 0.40 feet = final drawdown) to account for the precipitation event. This correction factor added an additional 7 monitoring wells to the list of wells with positive drawdown (MW-63, MW-64, MW-67, MW-102, MW-111, MW-119, MW-126). A distance-drawdown evaluation was also made using the uncorrected data for comparison purposes.

Anomalously high drawdown (recharge corrected: 5.18 feet) was recorded in MW-124 relative to the other wells surrounding the extraction well. This well is located approximately 40 feet from the extraction well MW-112, which itself had a drawdown of 9.31 feet, corrected for recharge. The data from

MW-124 was not used in the aquifer test evaluations. Conversely, two monitoring wells relatively close to the extraction well, MW-102 and MW-111 (both approximately 24 feet from MW-112), had increasing water table elevation displacements during the test, and only yielded mathematical drawdowns upon application of the regional water table elevation correction factor. The water table elevation effects in these wells were probably largely independent of groundwater extraction in MW-112, and thus were also not used in any of the hydraulic conductivity analyses.

As with the data associated with MW-77B described above, hydraulic conductivity (K) was calculated both "manually" utilizing the Cooper-Jacob "straight-line" distance-drawdown method and via Waterloo Hydrogeologic's Aquifer Test for Windows software, utilizing Cooper Jacob distance-drawdown and Cooper Jacob time-distance drawdown methods. The manual straight-line evaluations used manual gauging data, which were terminated in the field at 28 hours into the aquifer test. The Aquifer Test for Windows evaluations were conducted using transducer data, which recorded all 33 hours of the test. For ease of comparison, the distance draw-down evaluations conducted using Aquifer Test for windows were run at both 28 hours (1680) minutes and 33 hours (1980 minutes). Furthermore, the transducer data were not corrected for regional water table elevation increases, and fewer monitoring wells had transducers than were manually gauged. Time-distance drawdown evaluations were limited to those wells which had sufficient drawdown over the course of the aquifer test to generate drawdown vs. time curves (MW-120, MW-122 and MW-123).

The resulting K values from these evaluations were as follow:

Method	Wells Used	K (ft/day)
Cooper Jacob "Manual" Straight Line, Data Corrected for Regional Recharge	MW-60, MW-63, MW-64, MW-67, MW-70, MW-113, MW-120, MW-122, MW-123, MW-126, MW-140A, MW-140B	28.9
Cooper Jacob "Manual" Straight Line, Data Uncorrected for Regional Recharge	MW-60, MW-70, MW-113, MW-120, MW-122, MW-123, MW-140A, MW-140B	33.6
Aquifer Test for Windows Cooper Jacob Distance Drawdown at 1680 Minutes, Uncorrected for Regional Recharge	MW-113, MW-120, MW-122, MW-123, MW-140B	23.9
Aquifer Test for Windows Cooper Jacob Distance Drawdown at 1980 Minutes, Uncorrected for Regional Recharge	MW-113, MW-120, MW-122, MW-123, MW-140B	21.0
Aquifer Test for Windows Cooper Jacob Time-Distance Drawdown	MW-122, MW-123	28.1
Aquifer Test for Windows Cooper Jacob Time-Distance Drawdown	MW-120	11.6

Unlike the relatively consistent results obtained from the aquifer testing of MW-77B, these evaluations yielded variable results which are discussed in more detail below. The data graphs from the "manual" straight-line evaluations along with the software output from Aquifer Test for Windows are presented in Attachment III.

Discussion of Aquifer Testing in MW-112

The fact that equilibrium was not reached in the observation wells during the aquifer test, coupled with regional precipitation recharge/residual remedial pumping rebound during the aquifer test pose challenges in the interpretation of the aquifer test data. Incomplete drawdown complicates distance-drawdown evaluations, while precipitation events complicate time-drawdown evaluations due to the competing effects of groundwater extraction and regional recharge. Collectively, however, the data collected during this test can be used to constrain the hydraulic conductivity of the aquifer in this area within a relatively narrow range.

The anomalously rapid and concomitant drawdown in the recovery well MW-112 and nearby monitoring MW-124 could indicate that these wells are connected via highly transmissive material, interpreted to be potential bedrock fractures, which in turn is surrounded by material of lower transmissivity. Based on the drawdown in MW-112 and MW-124, the highly transmissive material appears to have been dewatered to some extent during the course of the aquifer test, effectively turning the area around MW-112 and MW-124 into one single, large diameter, recovery well of limited efficiency. The groundwater extraction effects of this area were then translated to the other surrounding monitoring wells with somewhat more uniform results. In addition, the drawdown/dewatering of the highly transmissive area surrounding MW-112 and MW-124 under relatively low extraction rates indicates that local to MW-112, this area is of limited aerial/volumetric extent.

The effects of the monitoring wells' incomplete drawdown are illustrated in the difference between the Aquifer Test for Windows distance-drawdown evaluations for 1680 and 1980 minutes. The additional drawdown realized in the five hours between these two intervals resulted in a K value reduction of nearly 3 ft/day from 23.9 to 21.0 ft/day. However, the Aquifer Test for Windows distance-drawdown evaluations are limited in the number of included monitoring wells, and as such, the "manual" straight-line evaluations are considered to be somewhat more representative, albeit on the high side due to their measurements being capped at 1680 minutes. Of the manual evaluations, the value corrected for regional groundwater recharge (28.9 ft./day) is considered most accurate, and is supported by the Aquifer Test for Windows time-distance drawdown evaluation for monitoring wells MW-122 and MW-123 (28.1 ft./day). The Aquifer Test for Windows time-distance drawdown evaluation of MW-120 yielded a low K value compared to MW-122 and MW-123, but this well's construction includes only 5 feet of saturated bedrock within its screened interval along with almost 10 feet of saturated unconsolidated overburden sediments. Monitoring wells MW-122 and MW-123's construction include 19 to 26 feet of saturated bedrock and between 0 and 0.28 feet of saturated overburden. The construction of extraction well MW-112 includes 21 feet of saturated bedrock and no saturated overburden. It appears that the varying bedrock representation of these wells may be affecting the hydraulic conductivity measurements in MW-120 relative to MW-122 and MW-123.

In light of these factors, the actual hydraulic conductivity in the area of MW-112 is likely constrained on the upper end by the manual straight-line value calculated using the recharge correction (28.9 ft/day) and the Aquifer Test for Windows distance-drawdown value calculated at 1980 minutes (21.0 ft/day). This hydraulic conductivity range is interpreted to be characteristic of the area outside of the more transmissive material connecting monitoring wells MW-112 and MW-124. Additionally, the general area influenced by the aquifer test appears to be highly constrained by subsurface geological heterogeneities. The area of influence is very narrow in the northerly and southerly directions, limited by monitoring wells MW-102 and MW-111, but relatively extensive east to west, stretching from MW-140A/B to MW-122. The more transmissive "core" of this area of influence, between MW-112 and MW-124, while perhaps limited in extent, also appears to have an east/west trend.

Conclusions

Based on the data and discussion presented above, the following conclusions and observations are offered:

- The average calculated hydraulic conductivity in the northeastern section of the site surrounding MW-77B is approximately 14.6 ft/day. Analyses of aquifer test data were relatively consistent between distance-drawdown and time-drawdown methods.
- The range in calculated hydraulic conductivity in the southwestern section of the site surrounding MW-112 is anticipated to be between 21.0 and 28.9 ft/day. Regional precipitation recharge and incomplete drawdown equilibrium during the course of the aquifer testing prevented a more precise estimate in this area.
- The area of influence of groundwater extraction from MW-112 is anisotropic, with an extensive reach east to west from MW-122 to MW-140A/B while being tightly constrained to the north and south by monitoring wells MW-111 and MW-102. The more transmissive material interpreted as connecting MW-112 and MW-124 also trends east/west. This east/west trend in hydraulic conductivity appears to mirror the trend/strike of geological heterogeneities at the site.

ATTACHMENT I

TABLES

Table 1
Manual Gauging Data
MW-77B Aquifer Test 4/13/06 to 4/14/06

Date/ Approx. Time of Samp. Round	Elapsed Time (minutes)	Monitoring Well (w/Distance from MW-77B in feet)														
		MW-77B (0.0)	MW-77A (4.0)	MW-77R (14.1)	MW-82 (57.4)	MW-83R (61.7)	MW-82R (72.6)	MW-80B (130.6)	MW-89 (155.2)	MW-106 (179.9)	MW-61B (184.5)	MW-61A (184.8)	MW-76P (211.1)	MW-81 (223.4)	MW-48A (268.2)	MW-48B (273.4)
4/13/2006 16:35	Pre-Test Gauging	20.23	20.58	20.97			16.11		29.37	10.12	53.38	29.93	26.10	11.73	31.33	29.96
4/13/2006 17:41	Pumping Start				T	T		T								
4/13/2006 17:45	4.00		20.56	21.44	r	r	16.07	r	29.35	10.11	53.38	29.30	26.09	11.73		
4/13/2006 18:00	19.00		20.61	21.60	a	a	16.08	a	29.35		53.39	29.92	26.11		31.33	29.85
4/13/2006 18:30	49.00		20.73	21.72	n	n		n				29.93		11.74		
4/13/2006 19:15	94.00		20.83	22.04	s	s		s	29.35	10.02	53.38	29.93	26.08	11.73	31.32	29.78
4/13/2006 19:45	124.00				d	d		d	29.35	10.13	53.39		26.07	11.74	31.31	29.71
4/14/2006 9:15	934.00		21.80	23.26	u	u	15.90	u	29.36	10.13		29.99	26.06	11.80	31.23	28.86
4/14/2006 10:00	979.00				c	c		c			53.36					
4/14/2006 10:30	1009.00				e	e		e				29.99				
4/14/2006 11:00	1039.00		21.85	23.34	r	r	15.90	r	29.34	10.12		29.99	26.04	11.89	31.32	28.77
4/14/2006 12:00	1099.00	26.05	21.90	23.38			15.89		29.33	10.11	53.35	29.99	26.04	11.81	31.32	28.67
4/14/2006 14:30	1249.00	26.08	21.93	23.42	O	O	15.86	O	29.30	10.11	53.34		26.23	11.81	31.32	28.55
4/14/2006 15:00	1279.00				n	n		n			53.32	30.00				
4/14/2006 16:30	1369.00	29.40	22.08	23.45	l	l	15.88	l	29.26	10.08	53.33	30.00	26.02	11.82	31.31	28.46
4/14/2006 17:30	1429.00	39.45	22.03	23.47	y	y		y	29.26	10.09		30.00	26.03	11.82	31.31	28.38
4/14/2006 18:00	1459.00						15.85				53.33					
Maximum Drawdown		**9.17**	**1.45**	**2.50**	**(0.17)**	**0.82**	**(0.26)**	**1.84**	**(0.11)**	**(0.03)**	**(0.05)**	**0.07**	**(0.07)**	**0.09**	**(0.02)**	**(1.58)**

Table 2
Manual Gauging Data
MW-112 Aquifer Test 5/11/06 to 5/12/06

Constant Rate Test Gauging Data									
Date/Time	**Minutes**	**MW-40**	**MW-55**	**MW-60**	**MW-63**	**MW-64**	**MW-67**	**MW-70**	**MW-71**
5/11/2006 8:00	0	24.78	28.96	22.88	18.07	11.92	14.71	22.75	25.49
5/11/2006 11:00	180	24.76	28.75	22.86	18.05	11.91	14.68	22.75	25.39
5/11/2006 13:00	300	24.75	28.68	22.86	18.04	11.91	14.67	22.74	25.35
5/11/2006 16:00	480	24.74	28.57	22.87	18.03	11.91	14.65	22.78	25.28
5/12/2006 0:00	960	24.86	28.42	22.91	18.04	11.62	14.56	22.77	25.14
5/12/2006 9:00	1500	24.39	28.30	22.93	18.01	11.67	14.49	22.77	24.99
5/12/2006 12:00	1680	24.68	28.26	22.94	18.03	11.65	14.47	22.77	24.94

Maximum Depth to Water (feet)	24.86	28.96	22.94	18.07	11.92	14.71	22.78	25.49
Minimum Depth to Water (feet)	24.39	28.26	22.86	18.01	11.62	14.47	22.74	24.94
Drawdown (feet)	-0.47	-0.70	0.08	-0.06	-0.30	-0.24	0.04	-0.55
Corrected Drawdown (+ 0.40 feet)	-0.07	-0.30	0.48	0.34	0.10	0.16	0.44	-0.15

Survey X Location (meters)	437726.18	437675.56	437677.46	437653.87	437607.34	437617.65	437742.68	437663.21
Survey Y Location (meters)	205568.82	205547.58	205519.52	205519.52	205501.91	205518.55	205469.91	205544.43
Distance from MW-112 (feet)	103.27	104.76	125.81	192.22	355.27	305.30	268.45	144.51

Positive Uncorrected Drawdown
Positive Corrected Drawdown

Table 2
Manual Gauging Data
MW-112 Aquifer Test 5/11/06 to 5/12/06

Constant Rate Test Gauging Data		**Depth to Water (feet)**								
Date/Time	**Minutes**	**MW-72**	**MW-102**	**MW-111**	**MW-112**	**MW-113**	**MW-116**	**MW-117**	**MW-118**	**MW-119**
5/11/2006 8:00	0	32.92	26.82	30.52	29.69	24.06	26.27	29.26	33.26	24.96
5/11/2006 11:00	180	32.66	26.82	30.36	31.68	24.05	26.10	29.17	33.19	
5/11/2006 13:00	300	32.54	26.82	30.32	32.95	24.06	26.05	29.17	33.16	
5/11/2006 16:00	480	32.43	26.82	30.30		24.05	25.95	29.08	33.10	
5/12/2006 0:00	960	32.22	26.81	30.29	36.28	24.12	25.80	28.95	33.11	25.11
5/12/2006 9:00	1500	32.07	26.78	30.23	38.50	24.13	25.68	28.82	32.88	
5/12/2006 12:00	1680	32.03	26.77	30.21	38.60	24.13	25.61	28.77	32.85	

Maximum Depth to Water (feet)	32.92	26.82	30.52	38.60	24.13	26.27	29.26	33.26	25.11
Minimum Depth to Water (feet)	32.03	26.77	30.21	29.69	24.05	25.61	28.77	32.85	24.96
Drawdown (feet)	-0.89	-0.05	-0.31	8.91	0.08	-0.66	-0.49	-0.41	-0.15
Corrected Drawdown (+ 0.40 feet)	-0.49	0.35	0.09	9.31	0.48	-0.26	-0.09	-0.01	0.25

Survey X Location (meters)	437699.95	437710.19	437705.66	437707.25	437671.44	437665.94	437660.17	437696.53	437714.72
Survey Y Location (meters)	205557.71	205536.13	205550.83	205543.67	205533.18	205540.07	205550.17	205565.67	205526.92
Distance from MW-112 (feet)	51.93	26.56	24.07	0.00	122.41	136.04	155.94	80.31	60.16

Positive Uncorrected Drawdown
Positive Corrected Drawdown

Table 2
Manual Gauging Data
MW-112 Aquifer Test 5/11/06 to 5/12/06

Constant Rate Test Gauging Data								
Date/Time	**Minutes**	**MW-120**	**MW-122**	**MW-123**	**MW-124**	**MW-126**	**MW-140A**	**MW-140B**
5/11/2006 8:00	0	25.31	30.72	23.74	27.75	36.09	17.67	17.10
5/11/2006 11:00	180	25.30	30.69	23.74	28.50	36.09	17.67	17.11
5/11/2006 13:00	300	25.37	30.70	23.77	29.10	36.08	17.68	17.11
5/11/2006 16:00	480	25.48	30.75	23.82	29.80	36.05	17.68	17.11
5/12/2006 0:00	960	25.73	30.89	23.97	31.16	36.05	17.69	17.12
5/12/2006 9:00	1500	25.90	30.96	24.05	32.23	36.01	17.70	17.12
5/12/2006 12:00	1680	25.95	30.96	24.08	32.53	36.07	17.69	17.12

Maximum Depth to Water (feet)	25.95	30.96	24.08	32.53	36.09	17.70	17.12
Minimum Depth to Water (feet)	25.30	30.69	23.74	27.75	36.01	17.67	17.10
Drawdown (feet)	0.65	0.27	0.34	4.78	-0.08	0.03	0.02
Corrected Drawdown (+ 0.40 feet)	1.05	0.67	0.74	5.18	0.32	0.43	0.42

Survey X Location (meters)	437723.89	437742.57	437699.09	437695.94	437721.50	437662.40	437659.40
Survey Y Location (meters)	205535.71	205537.82	205527.27	205539.34	205583.94	205502.20	205502.10
Distance from MW-112 (feet)	60.52	117.46	60.10	39.73	140.15	198.80	207.10

Positive Uncorrected Drawdown
Positive Corrected Drawdown

ATTACHMENT II

FIGURES

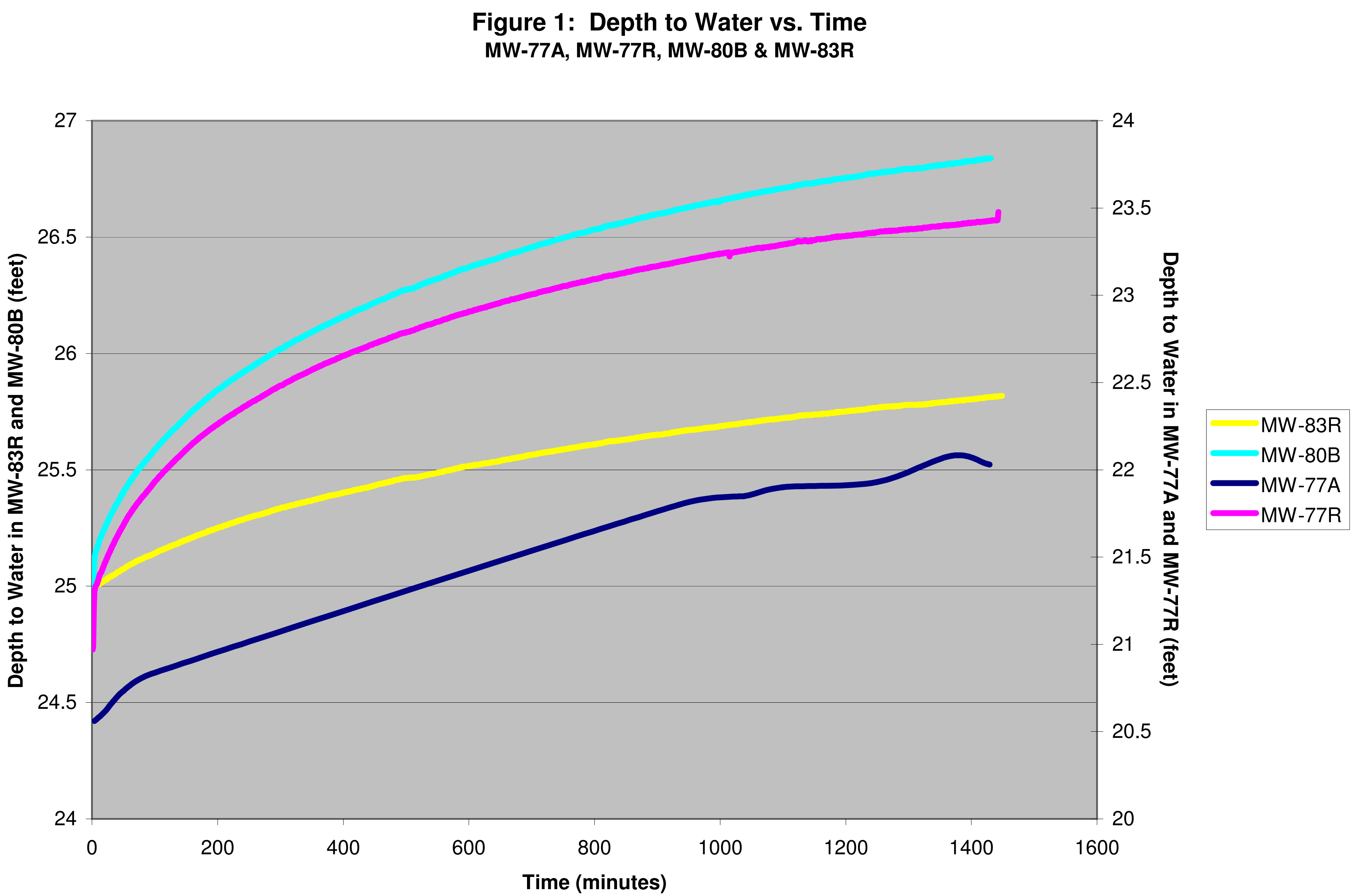


Figure 1: Depth to Water vs. Time
MW-77A, MW-77R, MW-80B & MW-83R
Depth to Water in MW-83R and MW-80B (feet)
Depth to Water in MW-77A and MW-77R (feet)
Time (minutes)
27
26.5
26
25.5
25
24.5
24
24
23.5
23
22.5
22
21.5
21
20.5
20
0
200
400
600
800
1000
1200
1400
1600
MW-83R
MW-80B
MW-77A
MW-77R

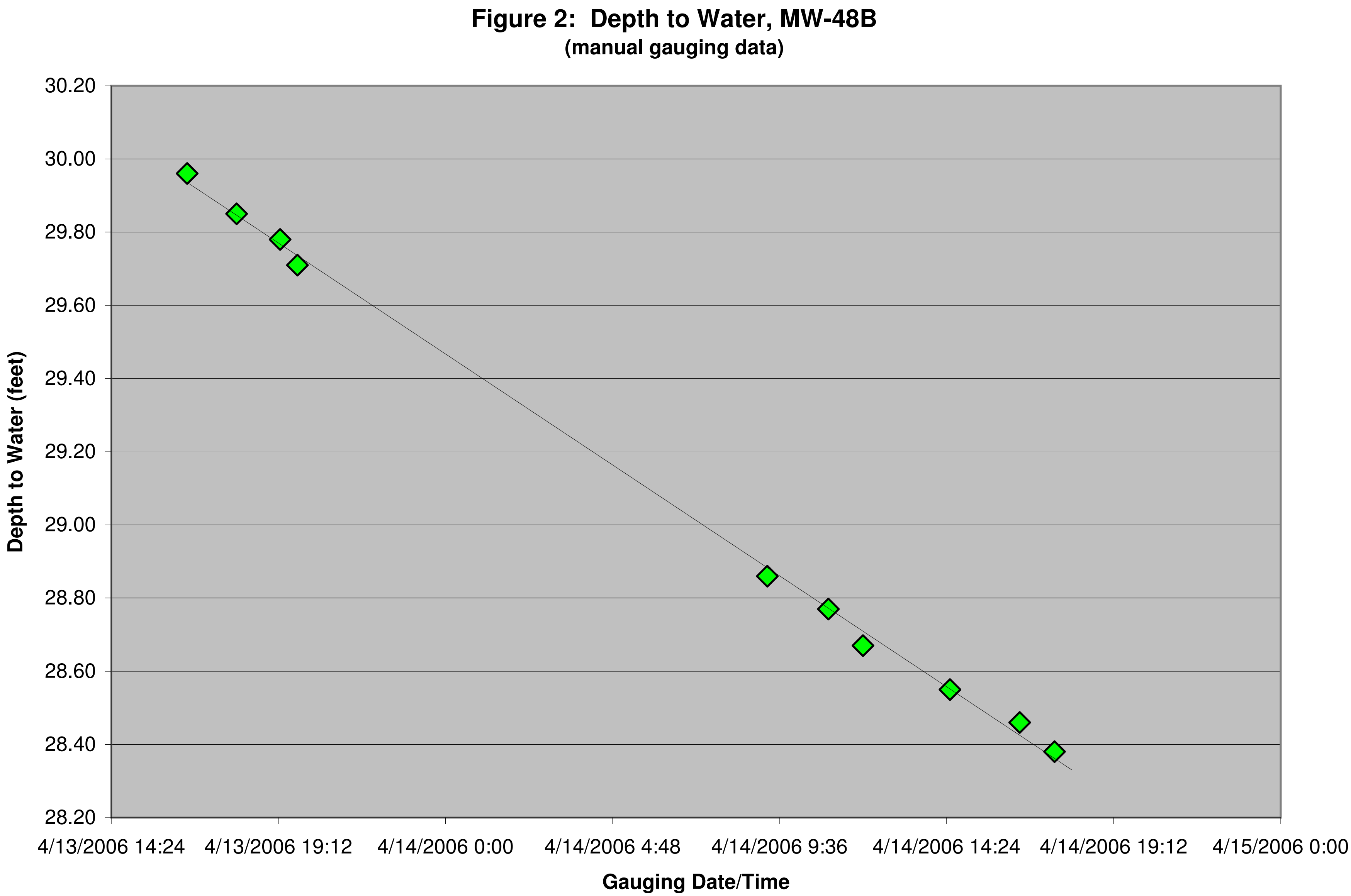


Figure 2: Depth to Water, MW-48B
(manual gauging data)
Depth to Water (feet)
30.20
30.00
29.80
29.60
29.40
29.20
29.00
28.80
28.60
28.40
28.20
4/13/2006 14:24
4/13/2006 19:12
4/14/2006 0:00
4/14/2006 4:48
4/14/2006 9:36
4/14/2006 14:24
4/14/2006 19:12
4/15/2006 0:00
Gauging Date/Time

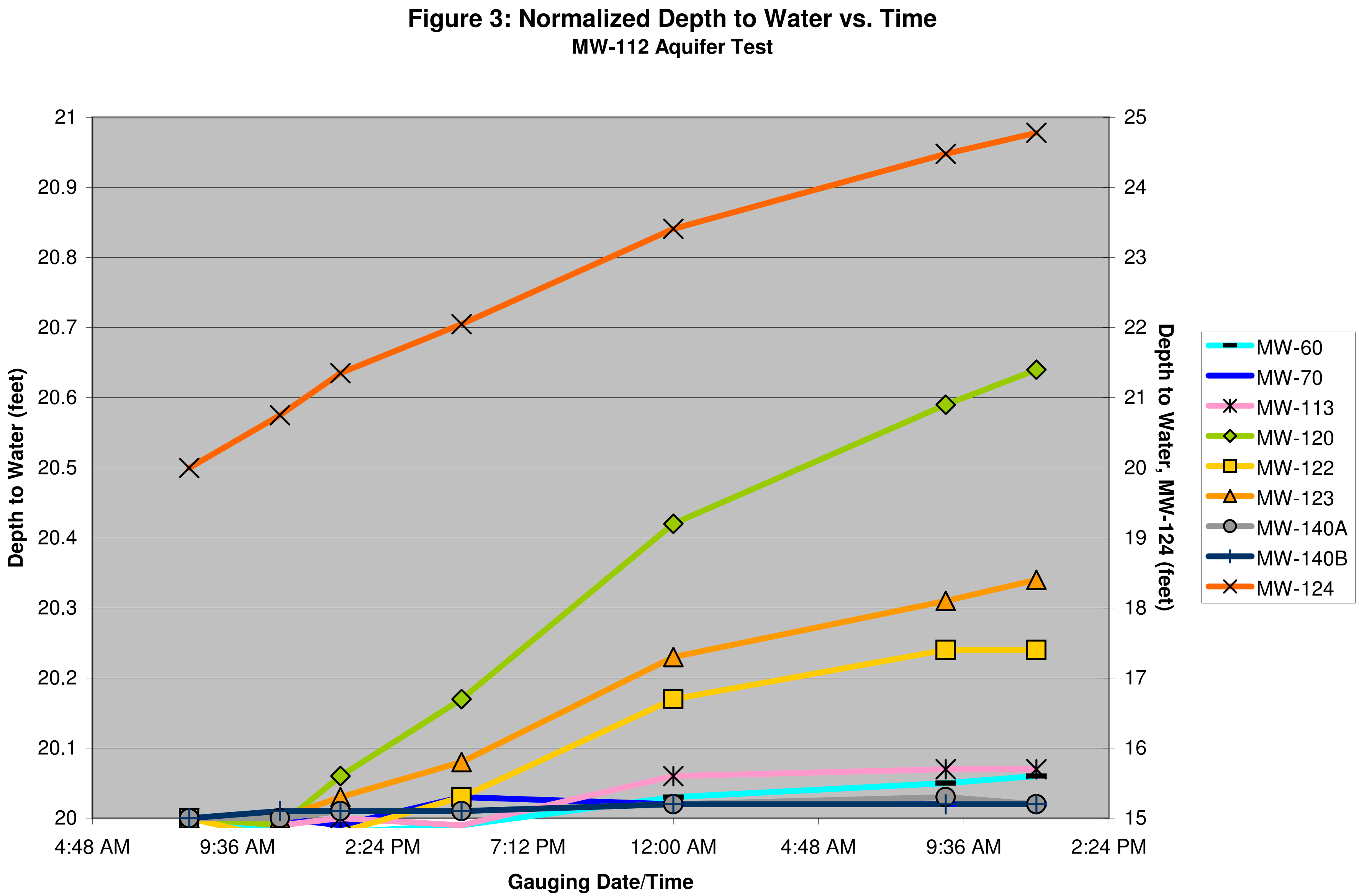
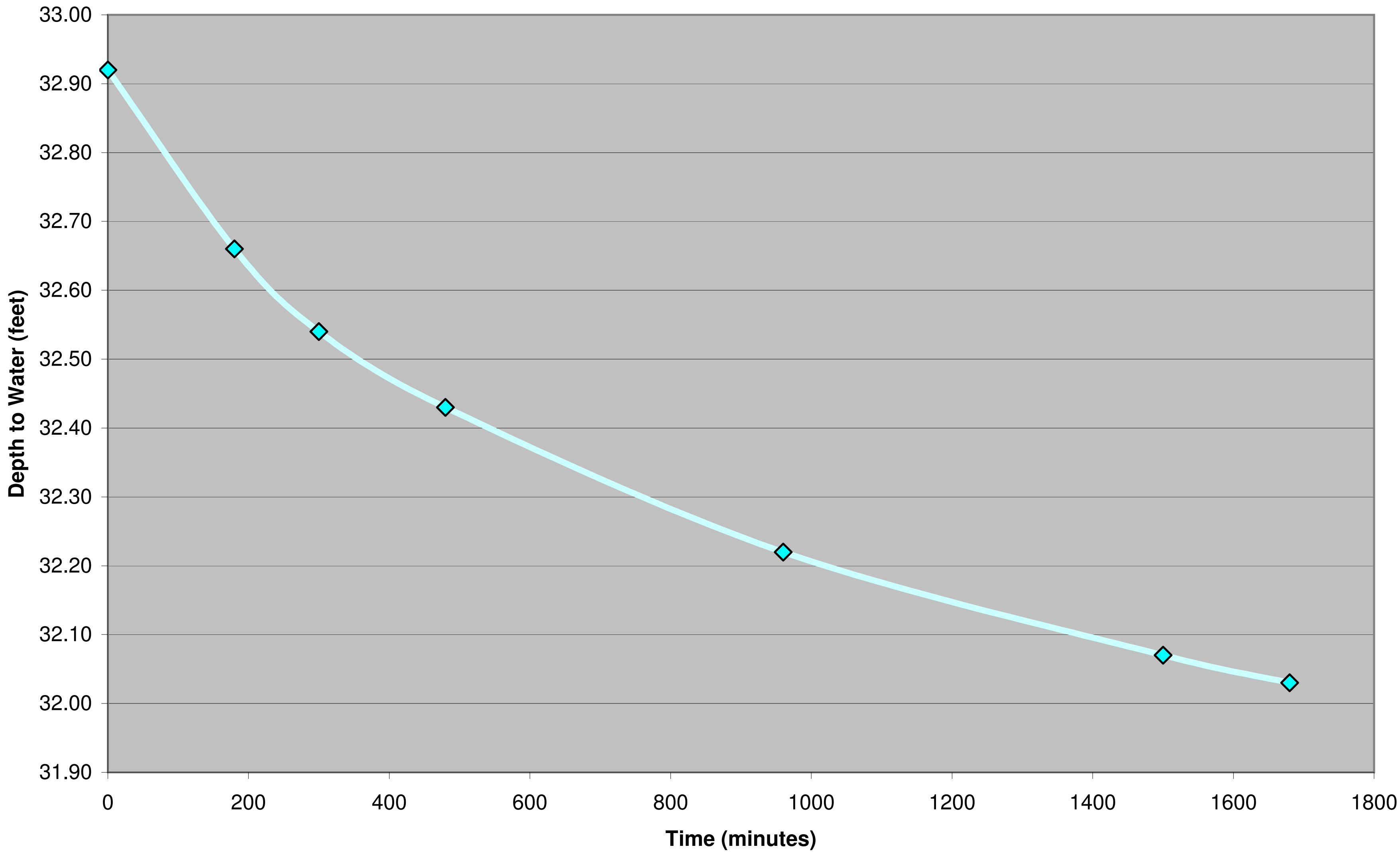


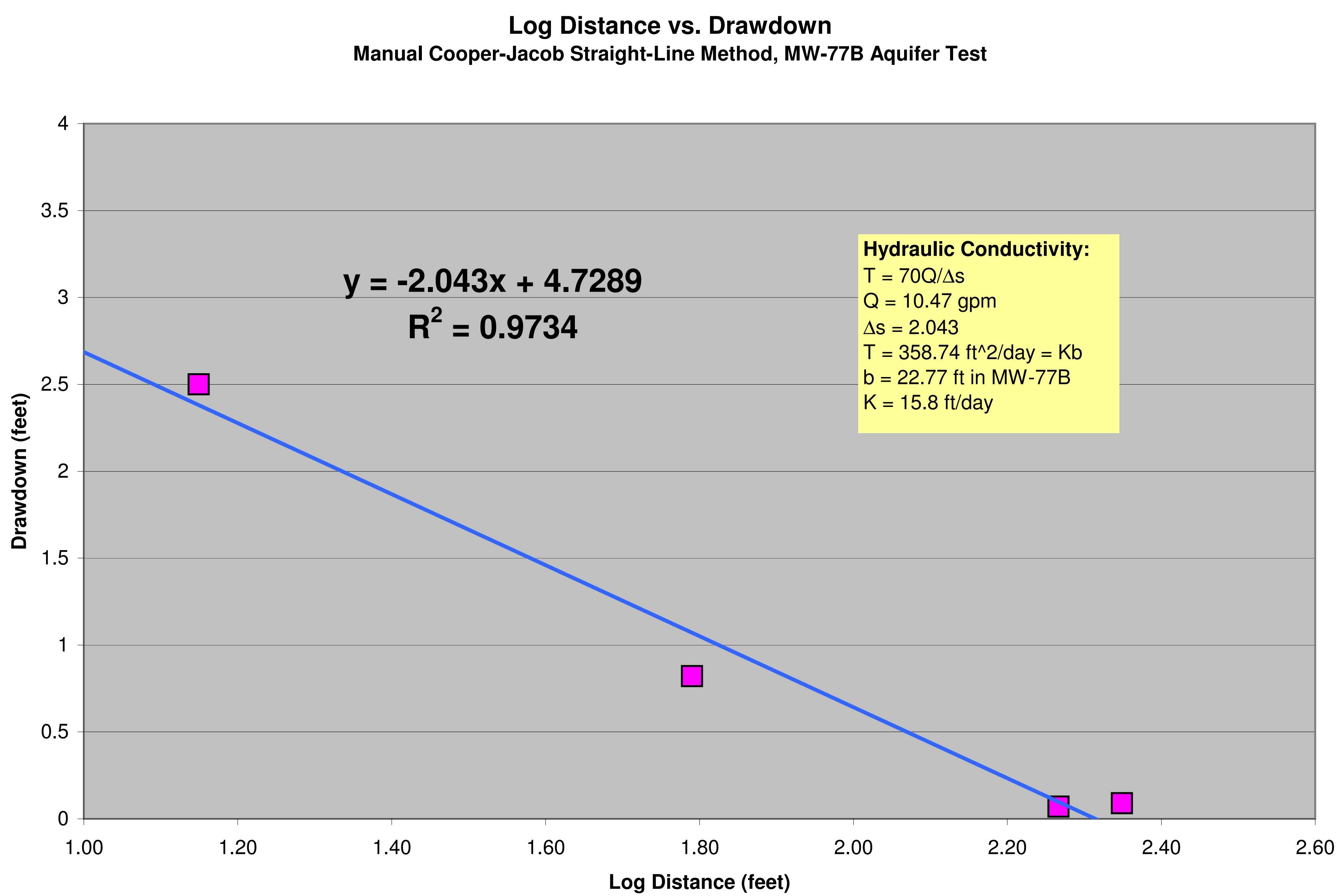
Figure 3: Normalized Depth to Water vs. Time
MW-112 Aquifer Test
Depth to Water (feet)
Depth to Water, MW-124 (feet)
Gauging Date/Time
21
20.9
20.8
20.7
20.6
20.5
20.4
20.3
20.2
20.1
20
25
24
23
22
21
20
19
18
17
16
15
4:48 AM
9:36 AM
2:24 PM
7:12 PM
12:00 AM
4:48 AM
9:36 AM
2:24 PM
MW-60
MW-70
MW-113
MW-120
MW-122
MW-123
MW-140A
MW-140B
MW-124

Figure 4: Depth to Water vs. Time in MW-72

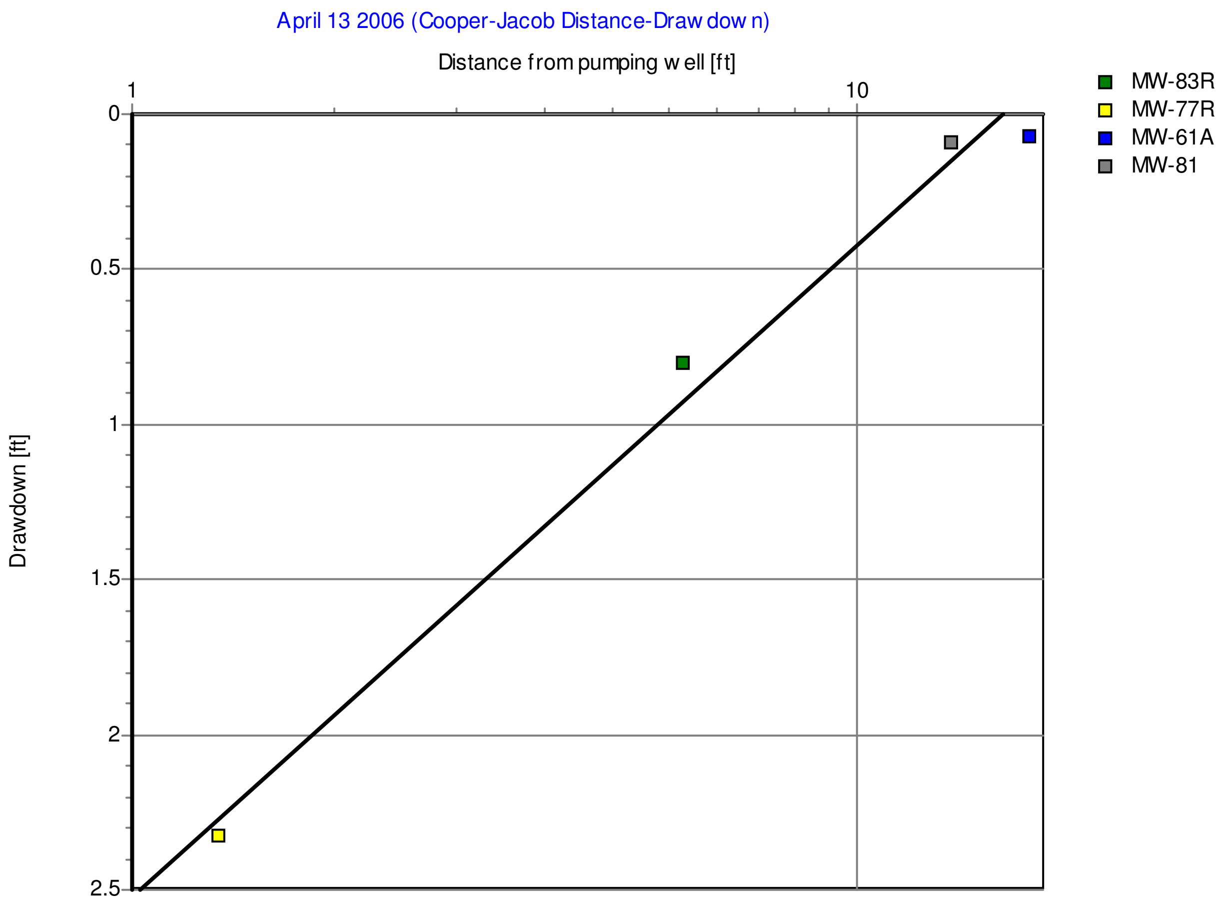


ATTACHMENT III

AQUIFER TEST FOR WINDOWS OUTPUT
"MANUAL" DATA REDUCTION OUTPUT


Log Distance vs. Drawdown
Manual Cooper-Jacob Straight-Line Method, MW-77B Aquifer Test
y = -2.043x + 4.7289
R2 = 0.9734
Hydraulic Conductivity:
T = 70Q/Δs
Q = 10.47 gpm
Δs = 2.043
T = 358.74 ft^2/day = Kb
b = 22.77 ft in MW-77B
K = 15.8 ft/day
Drawdown (feet)
Log Distance (feet)
0
0.5
1
1.5
2
2.5
3
3.5
4
1.00
1.20
1.40
1.60
1.80
2.00
2.20
2.40
2.60

Waterloo Hydrogeologic, Inc.	**Pumping Test Analysis Report**	
180 Columbia St. Unit 1104	Project:	Phoenix
Waterloo, Ontario, Canada	No:	60507606
Phone: +1 519 746 1798	Client:	



Test name:	**April 13 2006**
Analysis method:	**Cooper-Jacob Distance-Drawdown**

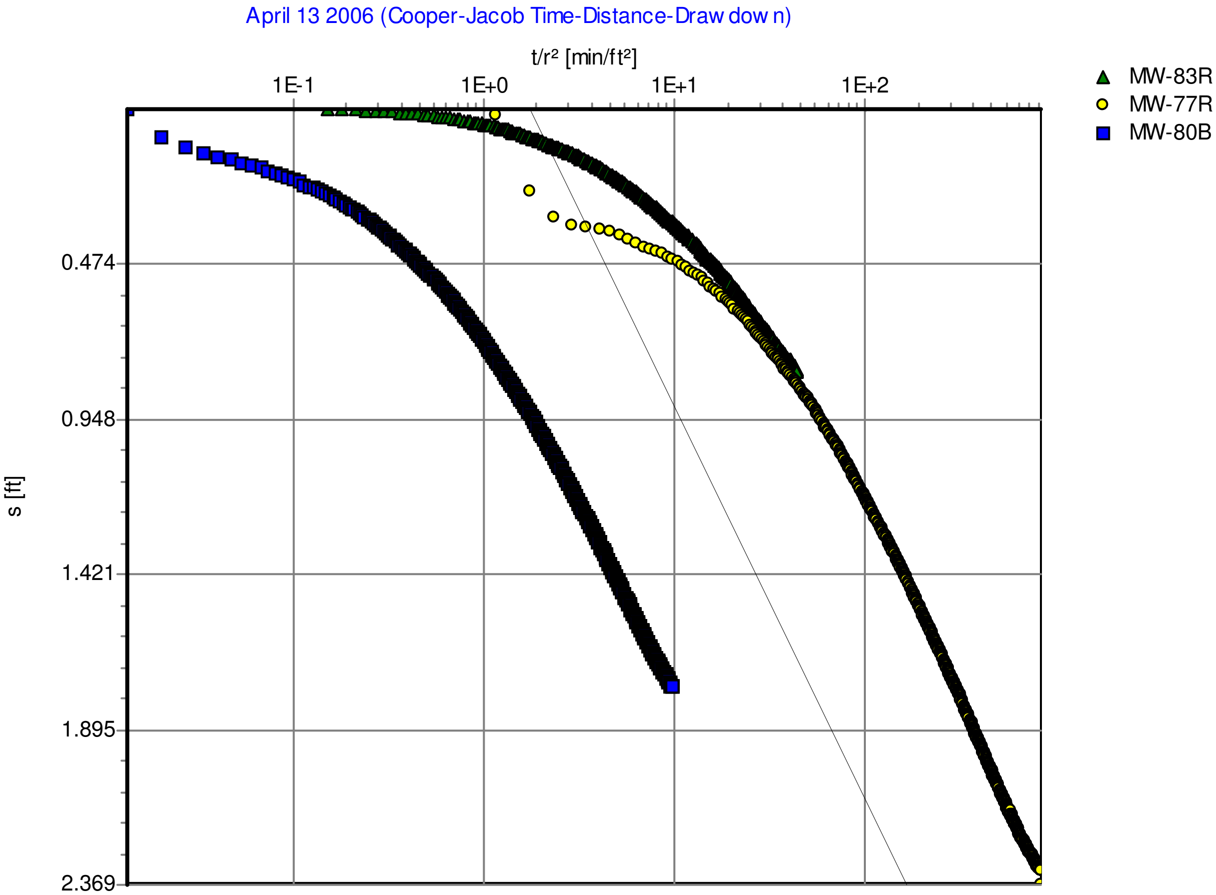
Analysis results:	Transmissivity:	3.52E+2 [ft²/d]	Conductivity:	1.55E+1 [ft/d]

Test parameters:	Pumping well:	MW-77B	Aquifer thickness:	22.77 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	10 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	10.479677 [U.S.		
	Calculation time:	1429 [min]		

Comments:

Evaluated by: Douthit/IAV
Date: 4/17/2006

Waterloo Hydrogeologic, Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone: +1 519 746 1798	**Pumping Test Analysis Report** Project: Phoenix No: 60507606 Client:



Test name: **April 13 2006**

Analysis method: **Cooper-Jacob Time-Distance-Drawdown**

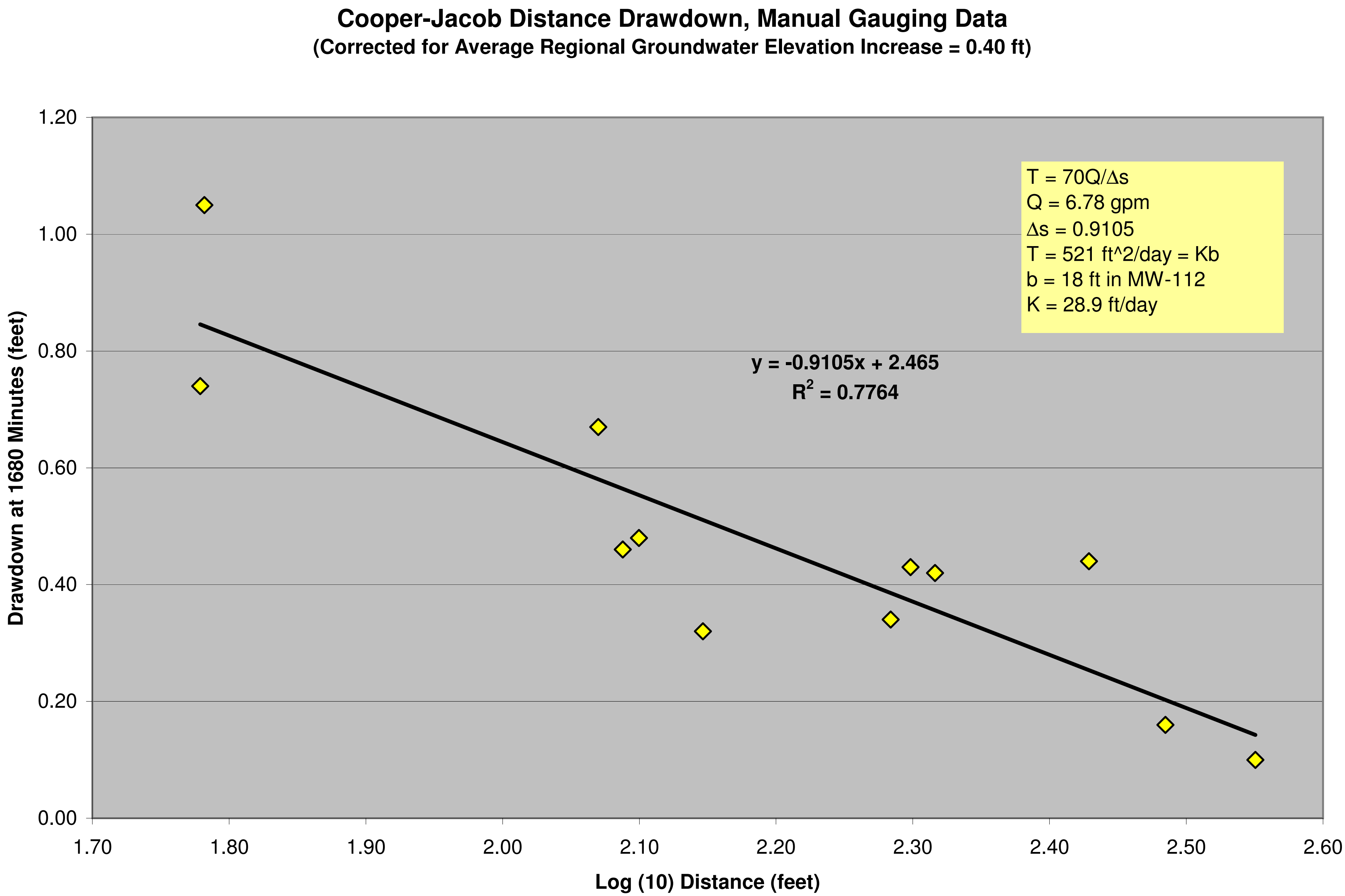
Analysis results:	Transmissivity:	3.09E+2 [ft²/d]	Conductivity:	1.36E+1 [ft/d]

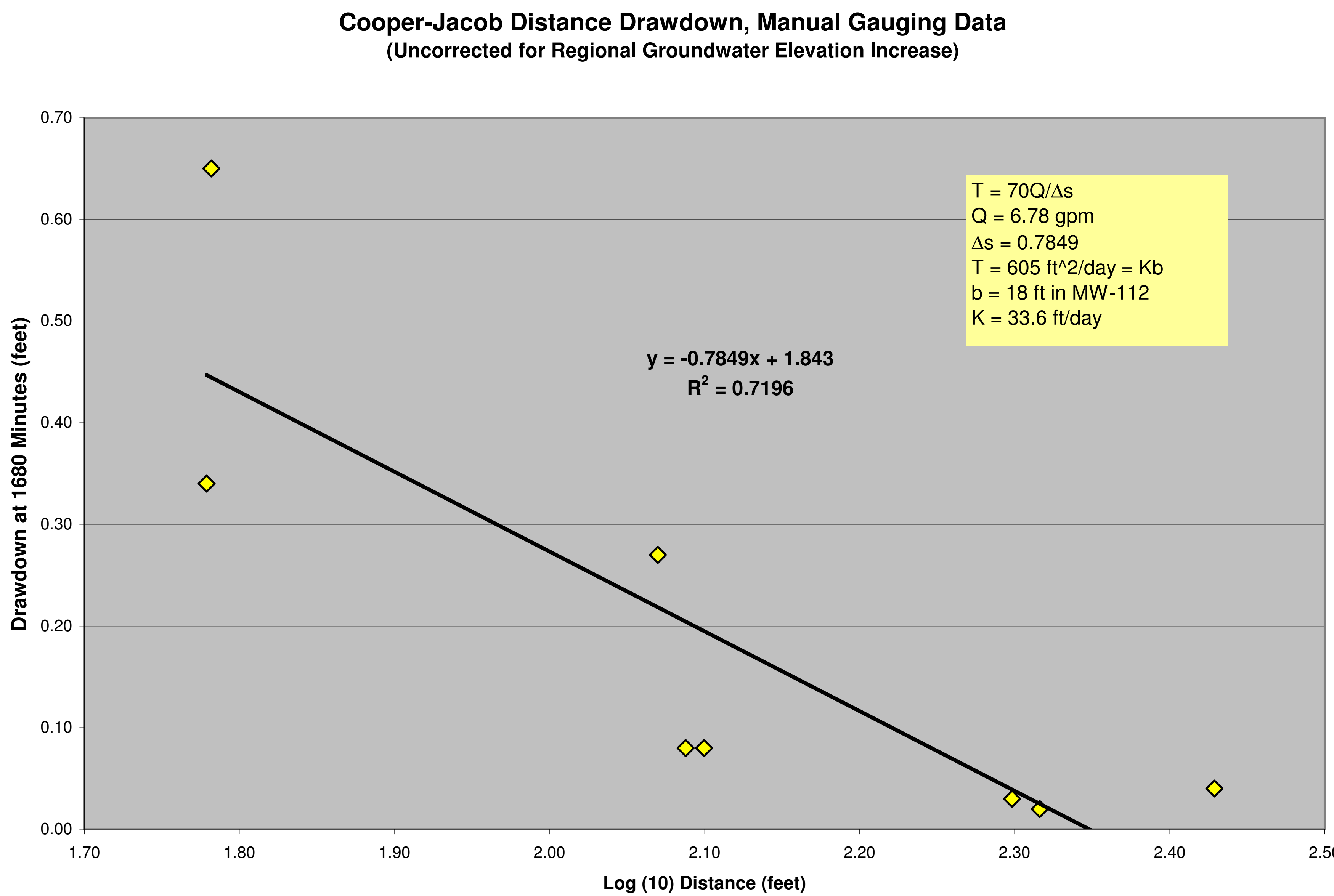
Test parameters:	Pumping well:	MW-77B	Aquifer thickness:	22.77 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	10 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	10.479677 [U.S.		

Comments:

Evaluated by: Douthit/IAV

Date: 4/17/2006

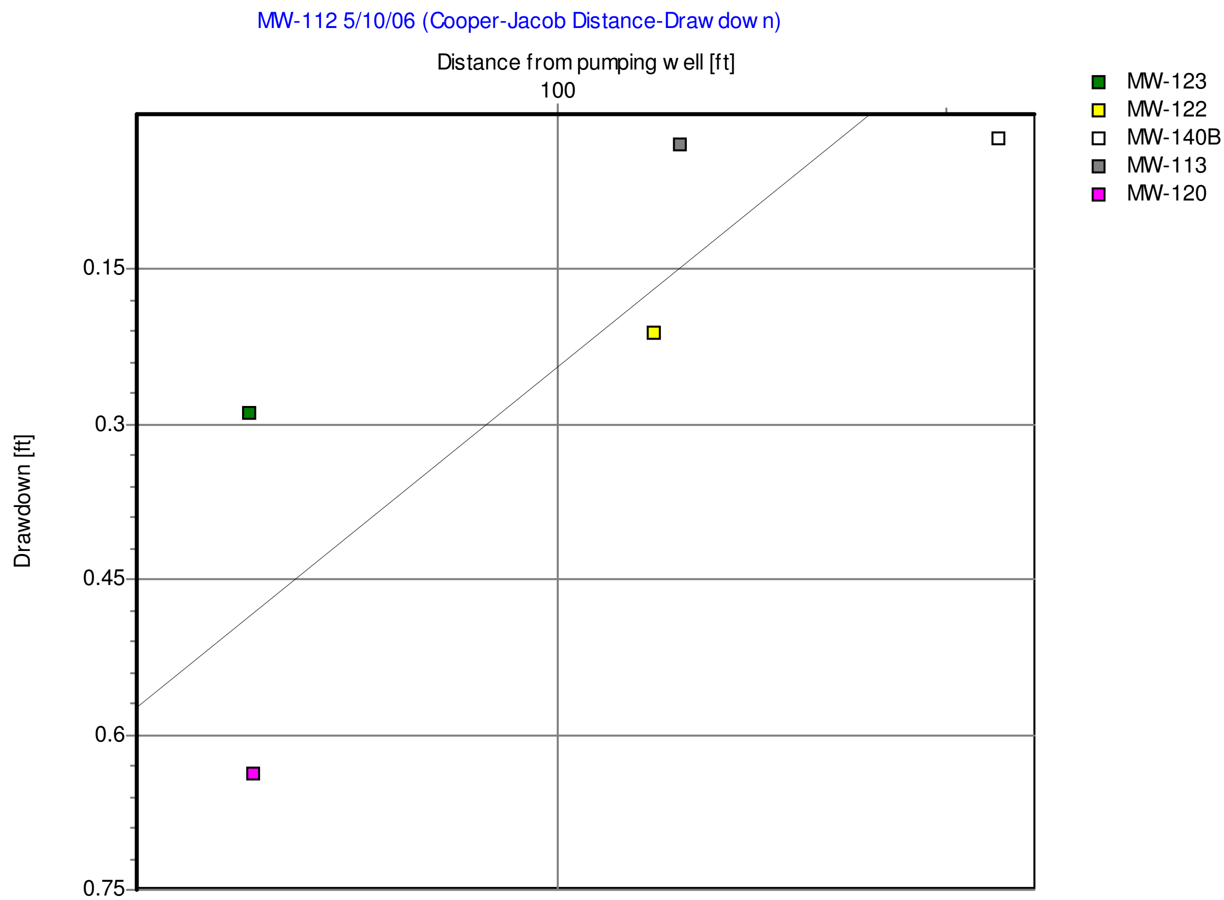

Cooper-Jacob Distance Drawdown, Manual Gauging Data
(Corrected for Average Regional Groundwater Elevation Increase = 0.40 ft)
T = 70Q/Δs
Q = 6.78 gpm
Δs = 0.9105
T = 521 ft^2/day = Kb
b = 18 ft in MW-112
K = 28.9 ft/day
y = -0.9105x + 2.465
R2 = 0.7764
Drawdown at 1680 Minutes (feet)
Log (10) Distance (feet)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
2.50
2.60


Cooper-Jacob Distance Drawdown, Manual Gauging Data
(Uncorrected for Regional Groundwater Elevation Increase)
T = 70Q/Δs
Q = 6.78 gpm
Δs = 0.7849
T = 605 ft^2/day = Kb
b = 18 ft in MW-112
K = 33.6 ft/day
y = -0.7849x + 1.843
R^2 = 0.7196
Drawdown at 1680 Minutes (feet)
Log (10) Distance (feet)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
1.70
1.80
1.90
2.00
2.10
2.20
2.30
2.40
2.50

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project:	Phoenix
No:	60507606
Client:	



Test name: **MW-112 5/10/06**

Analysis method: **Cooper-Jacob Distance-Drawdown**

Analysis results:	Transmissivity:	4.38E+2 [ft²/d]	Conductivity:	2.39E+1 [ft/d]

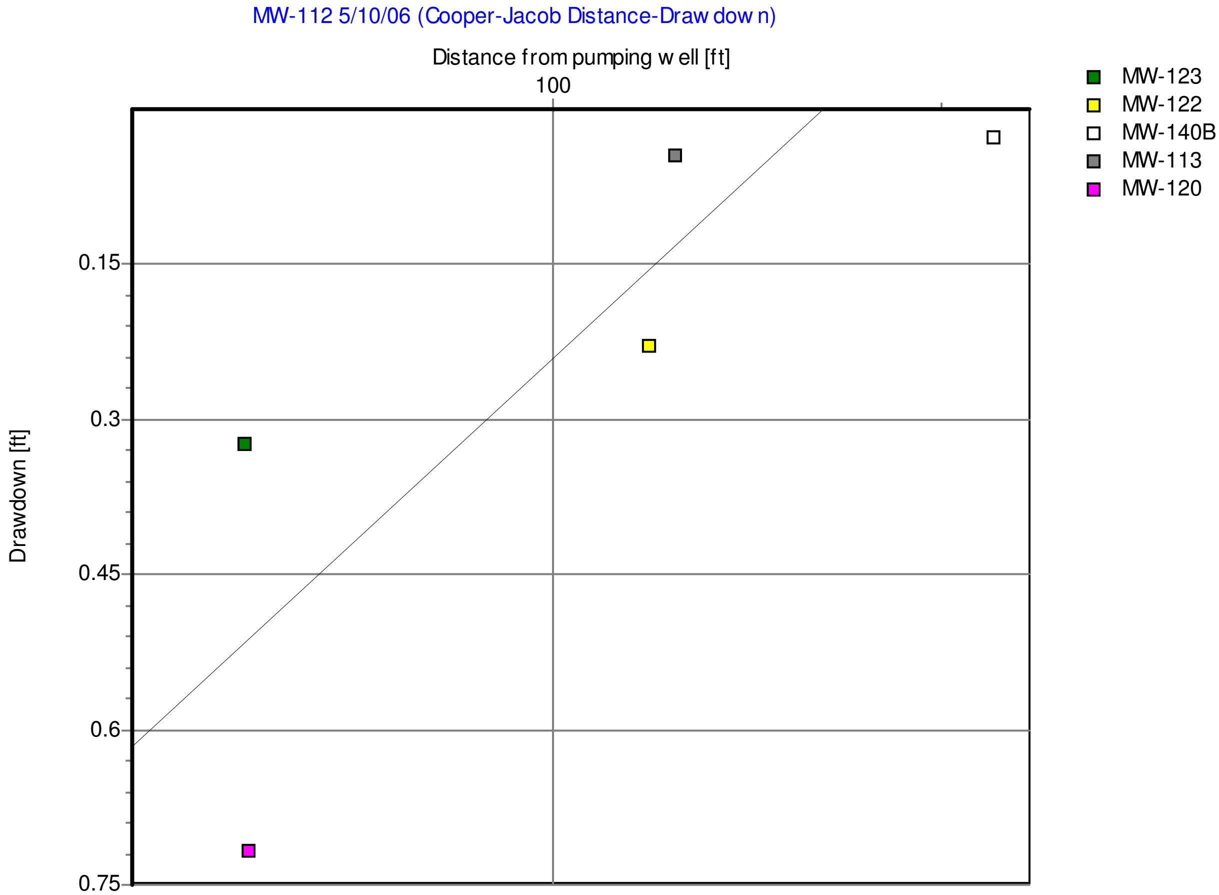
Test parameters:	Pumping well:	MW-112	Aquifer thickness:	18.31 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	18.31 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	6.7779821 [U.S.		
	Calculation time:	1680 [min]		

Comments:

Evaluated by: Douthit/IAV

Date: 5/17/2006

Waterloo Hydrogeologic, Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone: +1 519 746 1798	**Pumping Test Analysis Report** Project: Phoenix No: 60507606 Client:



Test name: **MW-112 5/10/06**

Analysis method: **Cooper-Jacob Distance-Drawdown**

Analysis results:	Transmissivity:	3.84E+2 [ft²/d]	Conductivity:	2.10E+1 [ft/d]

Test parameters:				
	Pumping well:	MW-112	Aquifer thickness:	18.31 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	18.31 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	6.7779821 [U.S.		
	Calculation time:	1980 [min]		

Comments:

Evaluated by: Douthit/IAV

Date: 5/17/2006

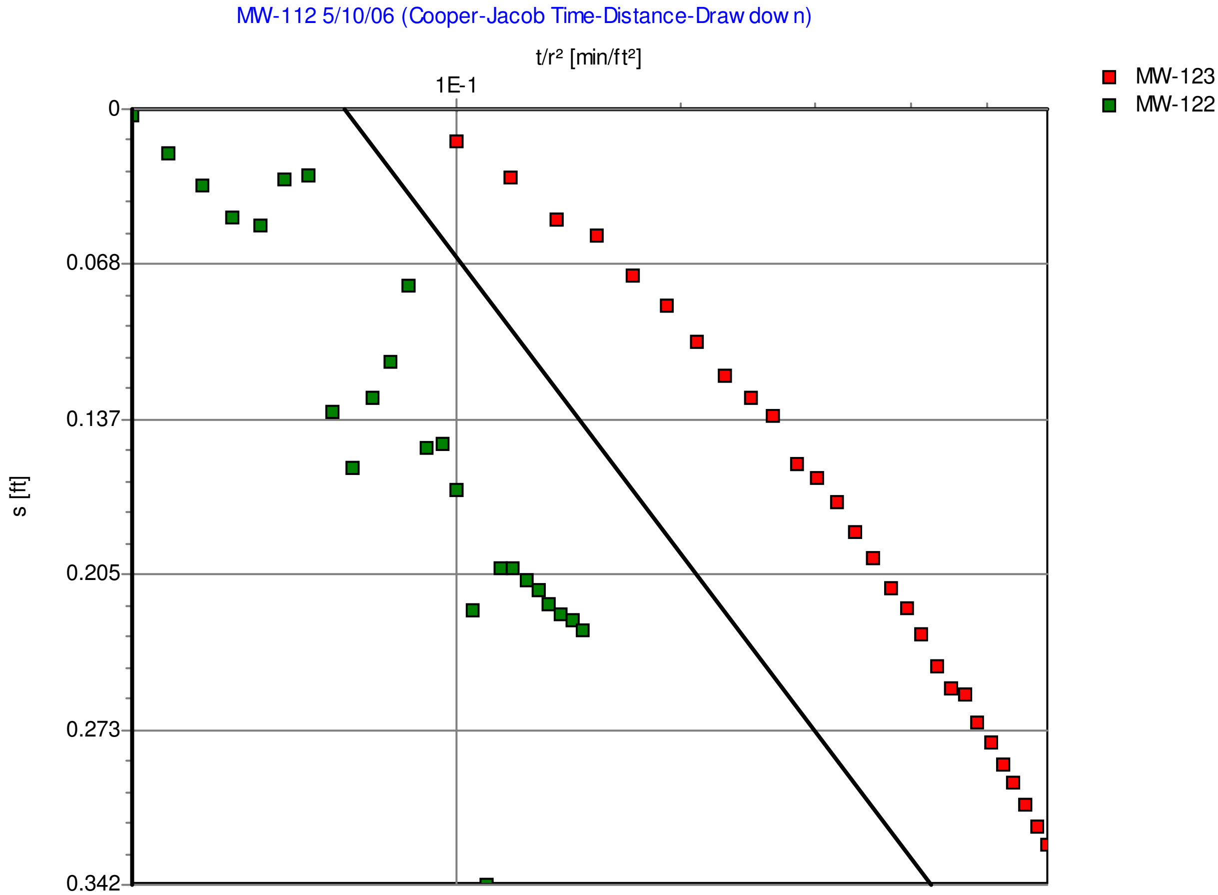
Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone: +1 519 746 1798

Pumping Test Analysis Report

Project: Phoenix

No: 60507606

Client:



Test name: **MW-112 5/10/06**

Analysis method: **Cooper-Jacob Time-Distance-Drawdown**

Analysis results:	Transmissivity:	5.14E+2 [ft²/d]	Conductivity:	2.81E+1 [ft/d]
Test parameters:	Pumping well:	MW-112	Aquifer thickness:	18.31 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	18.31 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	6.7779821 [U.S.		

Comments:

Evaluated by: Douthit/IAV

Date: 5/17/2006

Waterloo Hydrogeologic, Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
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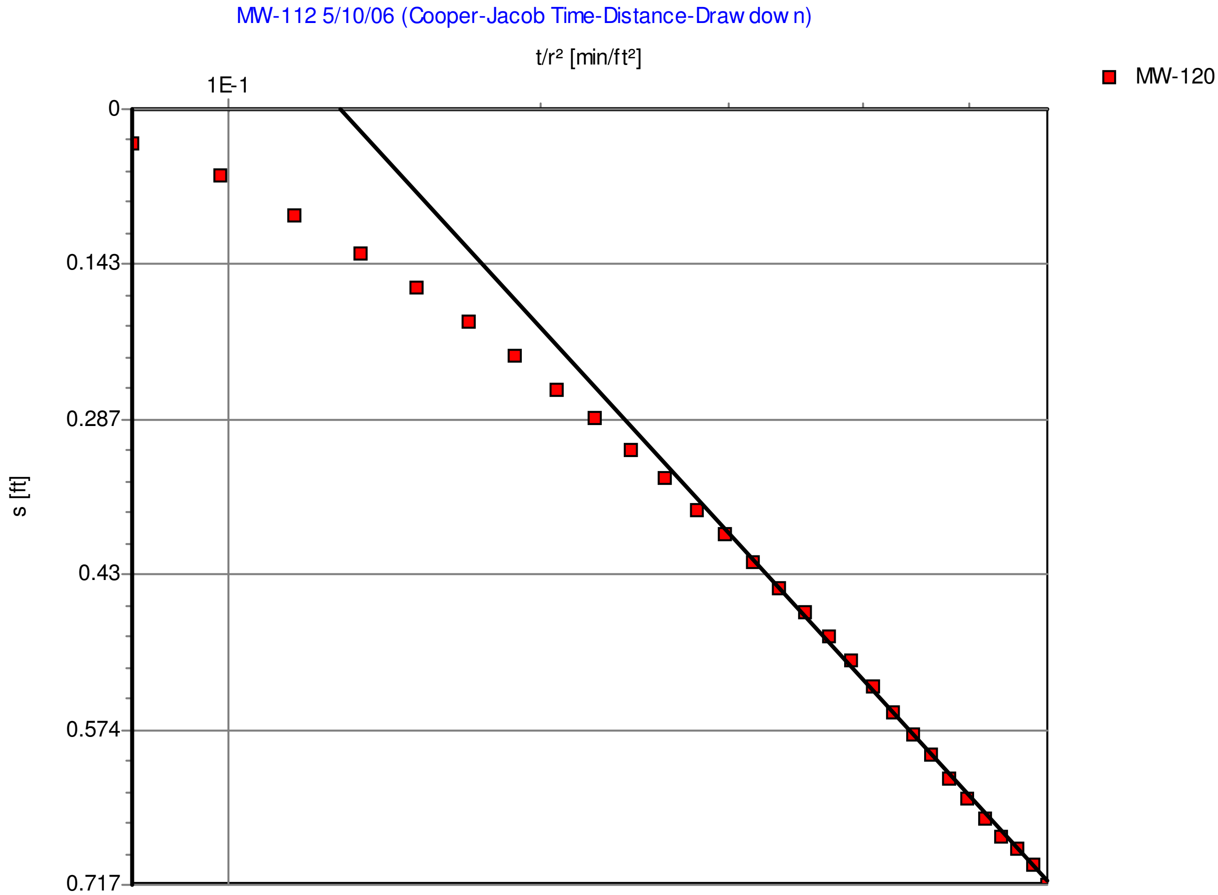
Pumping Test Analysis Report

Project:	Phoenix
No:	60507606
Client:	



Test name: **MW-112 5/10/06**

Analysis method: **Cooper-Jacob Time-Distance-Drawdown**

Analysis results:	Transmissivity:	2.12E+2 [ft²/d]	Conductivity:	1.16E+1 [ft/d]

Test parameters:	Pumping well:	MW-112	Aquifer thickness:	18.31 [ft]
	Borehole radius:	0.4167 [ft]	Unconfined aquifer	
	Screen length:	18.31 [ft]		
	Casing radius:	0.25 [ft]		
	Discharge rate:	6.7779821 [U.S.		

Comments:

Evaluated by: Douthit/IAV

Date: 5/17/2006