APPENDIX H

RW-2 MIDLE ROAD PUMP TEST REPORT
SEPTEMBER 2009

J.R. Holzmacher P.E., LLC

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January 19, 2010

Vincent J. Racaniello
Brookhaven National Laboratory
P.O. Box 5000
Upton, New York 11973

Re: Analysis and Conclusions for Middle Road Aquifer Pump Test

Dear Mr. Racaniello:

We have reviewed the results of the Middle Road aquifer pump test and offer the following for your consideration.

Background:

The Middle Road system consists of six pump and treat extraction wells that have been running since late 2001. The wells are numbered from RW-1 on the west to RW-6 on the east. While the system has been effective at removing VOCs, the evolution of the OU III plume has resulted in only low levels of contamination now found in the wells on the east end of Middle Road, with higher concentrations of VOCs still found on the west end in the vicinity of RW-1, RW-2 and RW-3.

RW-1 was screened shallow to address the plume as it existed in 2001. RW-2 is located to address the eastern portion of the plume "core" both laterally and vertically. However, the lateral extent of the core area is to the west of RW-1 as indicated on the attached figure.

The current plume configuration occurs across three separate geologic units that have different hydraulic characteristics. Reference is made to Figure 3.2.3-2 from the 2008 BNL Groundwater Status Report, which is west-east hydrogeologic cross section line E-E' for Middle Road. The uppermost layer contains the most coarse material and is referenced as "Upper Glacial" (UG) while the lowest layer is the most fine and considered to be Magothy (Ma). The layer sandwiched in between is the "Upton Unit" (UU) with characteristics intermediate between the surrounding layers.

RW-1 is screened in the Upper Glacial, RW-2 is screened in the Upton Unit and RW-3 is screened in the Magothy. There are limited observation wells available within each of the three strata. A pump test report from the original system startup offers some hydraulic information.

On-going groundwater monitoring and plume delineation activities during 2008 included construction of MR-MW-03-2008 (later permanently designated as MW 113-29) to the west of the plume near Middle Road. Samples from this well indicated that the edge of the plume extended farther west than previously observed.

Problem:

The existing configuration of RW-1, RW-2 and RW-3 may not now completely capture the more recently identified western edge of the plume encountered within the Upton Unit. The original pump in RW-2 demonstrated a peak flow rate of 172 gpm. In an effort to increase the capture zone a new larger pump was installed in RW-2, with a peak flow rate of over 300 gpm.

Aquifer Pumping Test:

An aquifer pumping test was performed to verify the effectiveness of pumping RW-2 at the 300 gpm flow rate and to enable prediction of the extent of plume capture to the west of RW-2. The test was designed to utilize RW-2 as a single pumping well and the rest of the Middle Road Remediation System pumping wells were turned off on Tuesday September 8, 2009 and remained off for the duration of the test. Solinst Leveloggers™ water level probes were installed in well RW-2 and 12 monitoring wells to record time and hydrostatic head data at one-minute intervals on September 9, 2009 and allowed to monitor the pre-test (non-pumping) data until pumping was started. The RW-2 pump was started on Thursday September 10 at 2 PM and remained in operation until 9:54 AM on Thursday, September 17, 2009. The data were downloaded and the water level probes retrieved on September 18.

Precipitation during the test commenced on Thursday night and lasted until early Sunday morning. This corresponds to the approximate time interval from 500 minutes to 3,500 minutes into the pumping test. The total rain recorded at the Upton weather station during this period was 1.50 inches.

The RW-2 pump is equipped with a totalizing flow meter. The following readings were used to determine the average flow rates during the test.

Table 1 – Aquifer Pumping Test Flow Rates

Date & Time	Time Interval (minutes)	Meter Reading (gallons)	Interval Pumpage (gallons)	Average Flow Rate (gpm)
9/10/09 - 2:07 PM		5486500		
9/14/09 - 10:11 AM	5524	7184320	1697820	307.4
9/17/09 - 9:54 AM	4303	8500620	1316300	305.9

The locations of the wells along Middle Road are shown on Figure 1, with a west-east cross section along Middle Road shown in Figure 2. The following table contains details on the

screened intervals of the wells, the formation within which each is screened, and the distance of each well from RW-2 used for the pump test analysis.

Table 2 – Summary of Wells Used During Aquifer Pumping Test				
Well:	**Distance to RW-2**	**Screen Depth (Feet BLS)**	**Formation**	**Drawdown at 9835 Min (feet)**
RW-2	0	170-200	Upton Unit (UU)	22.24
RW-4	565.4	150-180	UG/UU	0.29
105-66	412.9	179-189	Upton Unit	0.43
113-06	397.0	45.5-55.5	Upper Glacial	0.36
113-07	385.4	94-104	Upper Glacial	0.20
113-08	406.0	137-147	Upper Glacial	0.36
113-09	365.9	217-227	Magothy	0.41
113-11	141.9	196-206	Upton Unit	2.80
113-16	312	100-120	Upper Glacial	0.91
113-17	311.9	167-187	UG/UU	0.35
113-21	77.2	180-190	Upton Unit	6.25
113-22	107.4	235-245	Magothy	0.02
113-29	589.7	180-200	Upton Unit	0.05

Analysis:

The goal of the pump test included a projection of the effective capture zone of RW-2 without the full expense of calibrating and running a groundwater flow model. The existence of three strata with differing hydraulic characteristics and no aquitards between them complicates the analysis.

The data analysis included several steps. The first consists of direct observation of drawdowns within the selected wells. Aqtesolve software by Hydrosolve Corp. software was used to analyze the pumping test data for each well and to allow iterations with different starting assumptions. The software allows direct importation of Levelogger data as comma-separated-value (csv) files. The Leveloggers measure the height of the water column above the instrument detector, a pressure transducer, which is corrected for temperature. Direct data importation is designed to avoid transcription errors and to automate the process.

The assumptions used for the attached plots include the following:

- Aquifer Characteristics – Unconfined, stratified, with 10:1 (h:v) anisotropy
- Pumping Rate: 307 gallons per minute (gpm) based on totalizing meter readings
- Pumping well and observation wells are partially penetrating
- Saturated thickness 200 feet at the pumping well. (Note: Input saturated thickness in Well 113-22 = 235 feet and 113-29 = 250 feet due to software requirement relative to well depth)

Hydraulic conductivity and storativity values were calculated from the drawdown curves and compared with values calculated from previous aquifer pump tests. Professional judgment was used to select parameters to result in the "best fit" to the drawdown curves.

The Aqtesolve results are tabulated below with the wells sorted by screen depth:

Table 3 – Summary of Aqtesolve Analyses

Well No.	Transmissivity (T) ft^2/day	Storativity (S) dimensionless	Method & Comments
Wells Listed Below are Screened in the Upper Glacial Aquifer:			
113-06	1.173×10^4	0.07809	Theis T & S values are reasonable
113-07	1.225×10^4	0.0586	Cooper-Jacob T & S values are reasonable
113-16	1.844×10^4	0.006418	Theis T & S values are reasonable
113-08	2.745×10^4	0.02444	Theis T & S values are reasonable
UG/UU RW-4	1.968×10^4	0.03728	Theis T & S values are reasonable
Wells Listed Below are Screened in the Upton Unit:			
113-17	1.95×10^4	0.1145	Theis T & S values are reasonable
105-66	3.535×10^4	0.0136	Theis T & S values are reasonable
113-21	1.994×10^4	2.218×10^{-11}	Cooper-Jacob S value unreasonably low
RW-2 *	1.173×10^4	0.07809	Theis T & S values are reasonable
113-29	6.058×10^4	0.1451	Cooper-Jacob T is higher than expected; S value is reasonable
113-11	1.983×10^4	6.669×10^{-5}	Theis S value unreasonably low
Wells Listed Below are Screened in the Magothy Aquifer:			
113-09	5.982×10^4	0.0004948	Theis T value is higher than expected for Magothy; S value low for unconfined
113-22	7.774×10^4	3.447	Theis T value is higher than expected for Magothy; S value unreasonably high

* RW-2 and well 113-06 were analyzed on the same graph as a two-well solution and the T and S values are the same for both wells based on the aquifer response between the two wells.

Discussion:

The Aqtesolve results were reasonably close between wells and the observed variations can be attributed to variations in well depth, screen length, and aquifer properties, plus the degree of judgment in the data curve matching and the methods selected to solve for the transmissivity and storativity. In certain cases (113-07 and 113-29) there was very little drawdown during the pumping test and Theis curve matching was dropped in favor of the Cooper-Jacob straight line analysis. Nevertheless, the transmissivity values were generally in line with USGS published ranges, whereas the storativity values fell between unconfined and semi-unconfined conditions. Storativity should more properly be called "specific yield" because the aquifer behaved more like a water table aquifer than a confined or semi-confined aquifer, as drawdown could be detected even at the top of the saturated zone in well 113-06.

The transmissivity ranged from 1.173 x 10^4 to 7.774 x 10^4 ft^2/day (87,740 g/day/ft to 581,495 gal/day/ft) and storativity ranged from 0.0004948 to 0.1451 (dimensionless) after omitting the unreasonably high and low values. The USGS transmissivity estimates for the Upper Glacial range between 100,000 and 200,000 gal/day/ft and slightly lower for the Magothy Formation.

The transmissivity values calculated for wells screened within the Upton Unit were not corrected for vertical leakage suspected to occur from above. The resulting values calculated from this test would therefore be higher than the "correct" values for these sands. It is believed that the impact of vertical leakage was especially large on the transmissivity values calculated for the wells located farthest from the pumping well, which included 105-66 and 113-29.

The water level data from the wells was generally "well behaved" during the test. Barometric data was logged in order to be able to examine fluctuations in atmospheric pressure during the period of the aquifer pump test. The baro-logger was located in a building several miles to the north in Shoreham, New York. The fluctuations in pressure were not deemed significant in comparison to the rainfall recharge and no correction was applied to the water level data. A plot of the barometric data fluctuations for a ten day period commencing several days prior to the start of pumping is shown in Figure 3.

Table 5 includes a summary of the drawdown observed in each well sorted by the distance between the well and RW-2. The table also contains a distance-drawdown plot with trend line which shows a reasonable fit between the observations, especially if the wells screened in the Magothy Aquifer are neglected.

Capture Area:

Capture areas for pumping wells within BNL groundwater remediation systems have been predicted using Jacob Bear's solution for a well in a uniform flow field. The accuracy of these predictions has been verified based on actual field measurements and monitoring of plume capture at other BNL remediation systems. In this case, several parameters are utilized from the pump test results, including the flow rate of 307 gpm, transmissivity of 1.97 x 10^4 ft^2/day for the Upton unit in the vicinity of RW-2, and indirectly the saturated thickness of 200 feet. The aquifer gradient i = 0.001848 is taken from water table data from the June 2009 Groundwater monitoring event. The resulting steady state capture zone is parabolic with the open end pointing "upstream" as shown in Figure 4. The calculations of the capture zone dimensions are contained in Table 4. The dimensions of this parabola are superimposed on the Middle Road area in Figure 5 labeled as the "Projected Capture Zone".

The transmissivity values for the Upton unit calculated from RW-2, MW-113-17 and MW-113-21 are quite consistent. However, any change in the transmissivity value toward the west will impact the effective capture zone. The transmissivity value calculated between RW-2 and MW-113-29 was higher but had only a small drawdown and was based on the Cooper-Jacob method. The impact of water moving downward from the coarser upper glacial sands under the

influence of pumping would also tend to increase this transmissivity value. The larger transmissivity value calculated from the MW-113-29 data is believed to be unrealistic.

The predicted effective capture zone is also shown on the cross section in Figure 6. The limits of capture, and the transmissivity on which it was based, were calculated using an effective saturated aquifer thickness of 200 feet. However, the capture zone is drawn to reflect the assumption that pumping well RW-2 will have negligible impact on the underlying Magothy Aquifer.

Conclusions & Recommendations:

The larger pump installed in RW-2 has demonstrated an ability to maintain flow rates of over 300 gpm and to establish a drawdown in water level of 0.05 feet in MW-113-29, located 590 feet to the west. The transmissivity values derived from the pump test observations are reasonable and within realistic ranges in comparison with published values for the aquifer.

The goals to be accomplished by operation of the Middle Road remediation system include capture of the "core" of the contaminant plume, generally considered to be that portion of the plume with contaminant concentrations above 50 ug/l. The contaminant concentration contour lines from the 2008 Site Wide Groundwater status report are included in Figure 5. The projected capture zone includes the entire area of the plume having TVOC concentrations above 50 ug/l within the Upton Unit and the Upper Glacial Aquifer.

The transmissivity values for most of the monitoring wells are very close to the value used to calculate the projected capture area, including wells screened in the Upper Glacial strata, which are the most coarse encountered in the Middle Road area. We conclude that the higher transmissivity values calculated form MW-113-29 and 105-66 were significantly increased by the influence of vertical leakage from the overlying Upper Glacial aquifer. A distance-drawdown plot included in Table 5 was examined to verify that these values are outliers.

We conclude that RW-2 operating at 300 gpm very likely captures the core area (>50 ug/l TVOC) of the plume. Portions of the plume to the west that might not be captured will tend to be drawn eastward, which will make their eventual capture by EW-3 of the South Boundary system more likely.

Actions can be taken to increase the confidence with which the western portion of the plume is captured. The projected capture area was predicted with the assumption that RW-2 was the only well operating. Continued operation of wells RW-1 at 100 gpm and RW-3 at 125 gpm will increase the capture area of the entire remediation system. Maximizing the volume of water recharged in the South Boundary/Middle Road recharge basins should also serve to deflect the plume toward the east.

The success of the capture of the western portion of the plume will be assessed through on-going groundwater monitoring activities. The extent of the plume over the next several quarters should be evaluated to verify that the Middle Road system is fully capturing it.

Thank you for the opportunity to work with you on this project. Please call me if you have any questions.

Very truly yours,
J.R. Holzmacher P.E., LLC

J. Robert Holzmacher, P.E.

Principal

JRH:j

Encl.

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Tables

Table 4
BNL Middle Road Remediation System
Well Hydraulics - Well No. RW-2

Design Flow Rate:	307	gpm	41.04	cfm	0.684	cfs	59097	cu.ft/day
	442080	gpd						
Well Depth:	200	Feet						
Screen Diameter:	8	inch (PIPE SIZE) =	0.67	feet				
Screen Radius:	4	inch (PIPE SIZE) =	0.33	feet				
Depth to Water:	0	feet						
Specific Capacity:	15.35	gpm per ft of drawdown						
Drawdown:	20.0	feet						

Hydraulic Parameters:

	Upton Unit			
K	736.8	gpd/sq.ft	98.5	Ft/Day
B	200	feet	200	feet
T	147366.2	gpd/ft	19700	Cu. Ft/Ft/Day

The average measured Transmissivity (MW 113-17, MW113-21) is used.

Zone of Capture:

Single pumping well in 2-dimensional uniform flow field - Ref. Jacob Bear, Hydraulics of Groundwater, 1979, P. 368.

key dimensions of parabolic capture zone are calculated as follows:

Downstream Distance to Stagnation Point = Xs = Q / 2 Pi q B = 258 feet

where;	Q	442080	gpd	pumping rate
	Pi	3.14159		
	q	1.36	gpd/sq. ft	regional flow rate per unit width
	B	200	feet	effective aquifer thickness

where; q can be estimated from Darcy's law as equal to K * I * A ; and

I	0.001848429		regional water table gradient
	39	1082	Values estimated from Q2 June 2009 groundwater contour lines
	37		

Half Width of Parabola Asymptote = Y = Q / 2 q B = 811.5 feet

Nonequilibrium Equation Prediction of Hydraulic Interference

NonEquilibrium Equation (Theis) for Homogeneous Isotropic Aquifer Segment - Ref. Johnson, Groundwater and Wells, 1986, P.219

Q = K * (H * H - h * h) / 1055 * log (R / r)

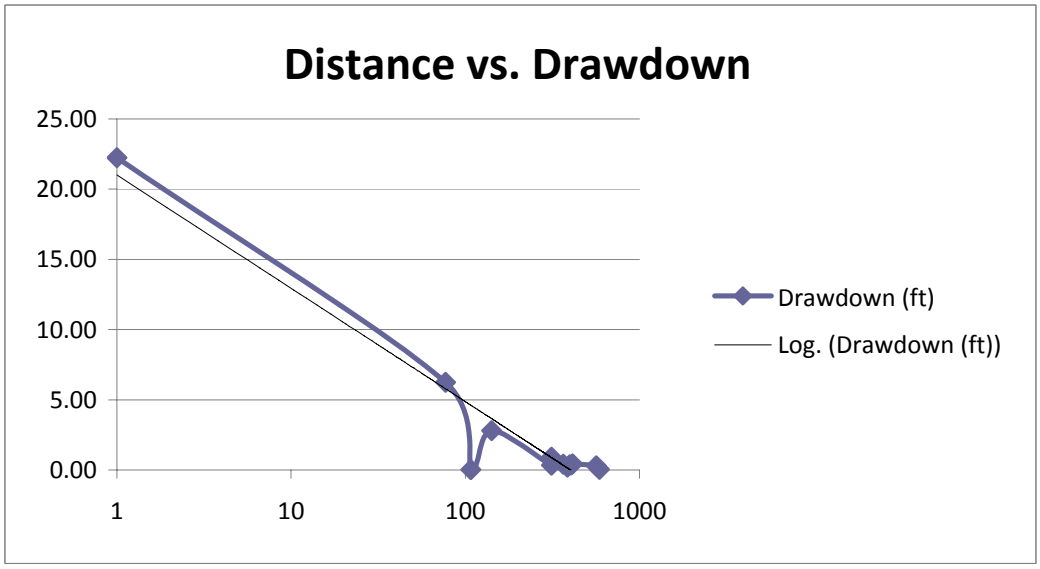
where;

Flow rate:	Q	307	gpm
Transmissivity:	T	147366.244	gpd/ft
Time of pumping:	t	60	days
Coeff. Of Storage:	S	0.0781	feet
Drawdown as f(t,r):	s	*Desired output*	feet
Distance to point:	r	100	feet
	0.3 Tt / r**2 S =	3396.840046	
	log (0.3 Tt / r**2 S)	3.531075097	
	264 Q / T	0.549976696	
	s =	1.94	feet
For r =			
200	0.3 Tt / r**2 S =	849.2100115	
feet	log (0.3 Tt / r**2 S)	2.929015106	
	264 Q / T	0.549976696	
	s =	1.61	feet
For r =			
250	0.3 Tt / r**2 S =	543.4944074	
feet	log (0.3 Tt / r**2 S)	2.73519508	
	264 Q / T	0.549976696	
	s =	1.50	feet
For r =			
300	0.3 Tt / r**2 S =	377.4266718	
feet	log (0.3 Tt / r**2 S)	2.576832587	
	264 Q / T	0.549976696	
	s =	1.42	feet
For r =			
350	0.3 Tt / r**2 S =	277.293065	
feet	log (0.3 Tt / r**2 S)	2.442939008	
	264 Q / T	0.549976696	
	s =	1.34	feet
For r =			distance to MW113-08
406	0.3 Tt / r**2 S =	206.0739187	
feet	log (0.3 Tt / r**2 S)	2.31402303	
	264 Q / T	0.549976696	
	s =	1.27	feet
For r =			distance to MW113-29
590	0.3 Tt / r**2 S =	97.58230526	
feet	log (0.3 Tt / r**2 S)	1.989371074	
	264 Q / T	0.549976696	
	s =	1.09	feet

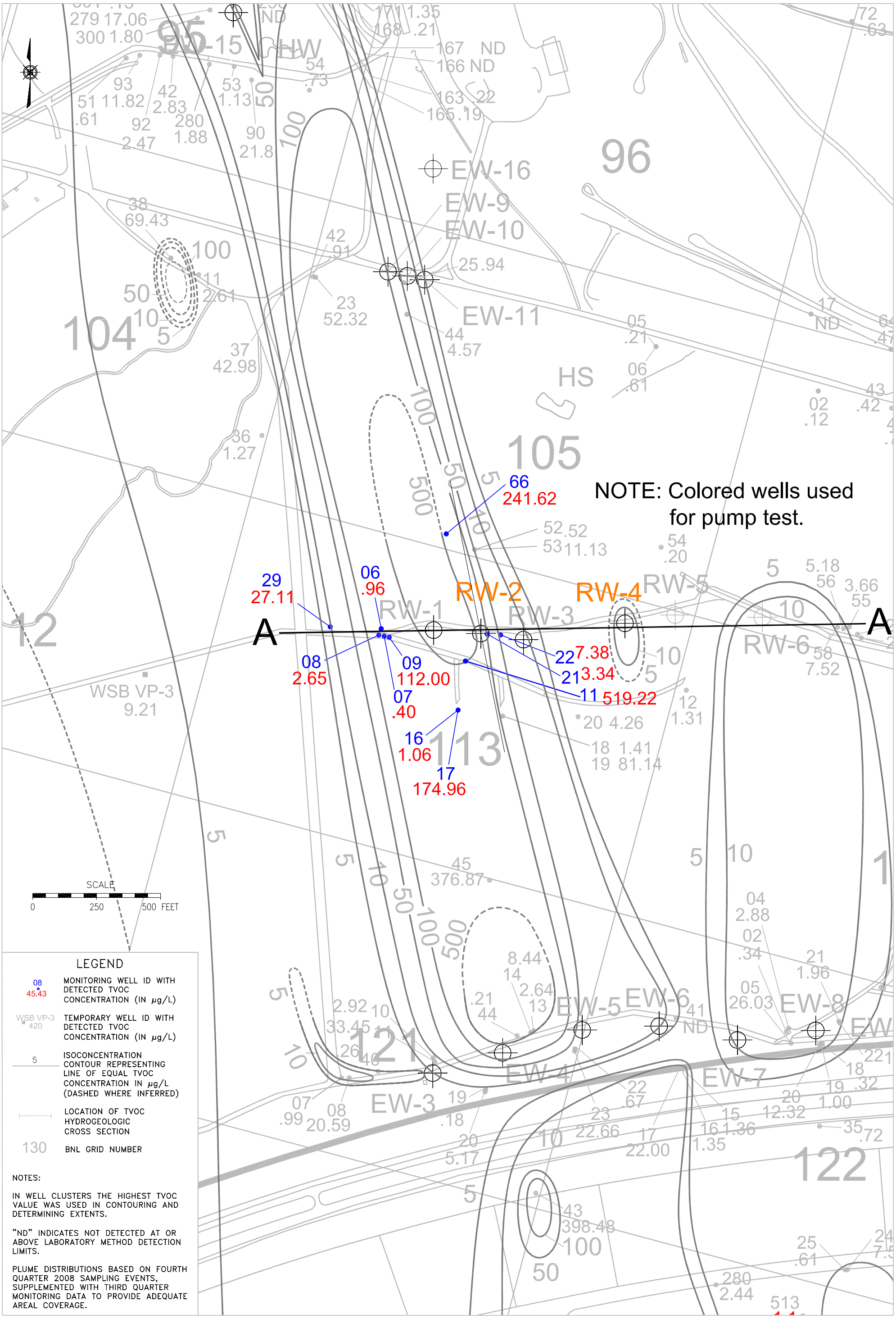
Table 5
BNL Middle Road Remediation System
Observed Drawdown in Water Level

Pump Test Start: 9/10/09 2:07 PM
Pump Test End: 9/17/09 9:54 AM

Well No.	Water Level Reading					
	Time	Feet	Time	Feet	Distance	Drawdown (ft)
RW-2	13:56:00	97.05	9:52:00	74.82	1	22.24
113-21	13:56:00	68.62	9:52:00	62.37	77.2	6.25
113-22	13:56:00	19.85	9:52:00	19.83	107.4	0.02
113-11	13:56:00	21.15	9:47:00	18.35	141.9	2.80
113-17	13:56:00	16.98	9:52:00	16.63	311.9	0.35
113-16	13:56:00	8.43	9:50:00	7.52	312	0.91
113-09	13:56:00	11.75	9:50:00	11.34	365.9	0.41
113-07	13:56:00	17.30	9:50:00	17.10	385.4	0.20
113-06	13:56:00	59.20	9:50:00	58.84	397	0.36
113-08	13:56:00	59.20	9:50:00	58.84	406	0.36
105-66	13:56:00	64.03	9:50:00	63.60	412.9	0.43
RW-4	13:56:00	12.65	9:52:00	12.35	565.4	0.29
113-29	13:56:00	0.96	9:52:00	0.92	589.7	0.05



Figures



BROOKHAVEN NATIONAL LABORATORY

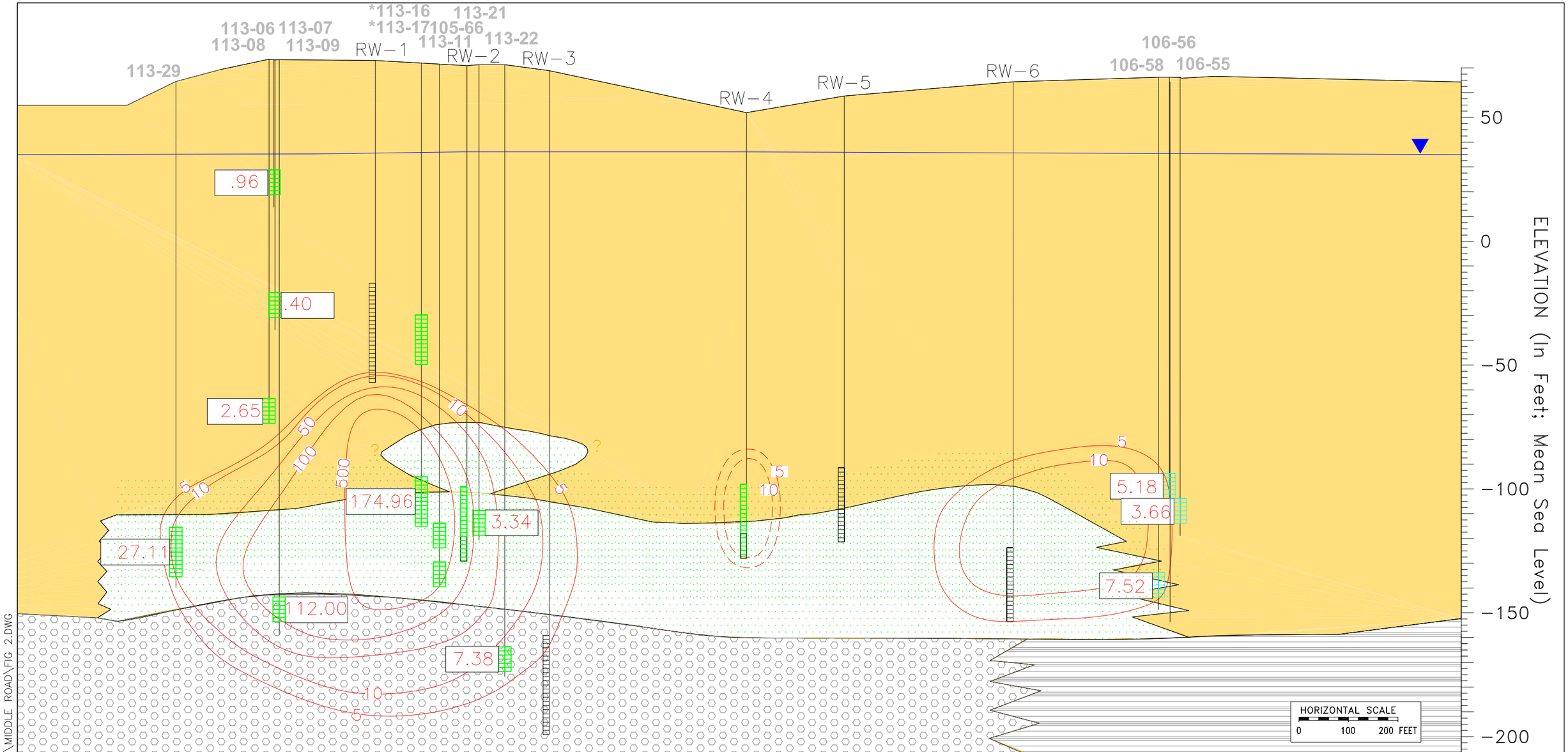
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

MIDDLE ROAD WELL LOCATIONS AND TVOC PLUME DISTRIBUTIONS

RW-2 MIDDLE ROAD PUMP TEST REPORT – SEPT. 2009

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	–	01/20/10	–
CHKD:	APPD:	REV.:	NOTES:
JRH	–	–	–
FIGURE NO.:			
1			



Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay

- GL Gardiners Clay
- GS Gardiners Clay – Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undifferentiated)

RW–1 Extraction Well

113–06 BNL Well ID

1.84 TVOC Concentration (µg/L)

5 TVOC Contour (µg/L) (Dashed Where Inferred)

Water Table As Of November 17–21, 2008

Monitoring Well Screen

Extraction Well Screen

Wells Utilized in Pump Test

NOTES:

1) GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, MORE DETAILED REPORTS.

2) PLUME DISTRIBUTION BASED ON FOURTH QUARTER 2008 OU III SAMPLING EVENTS.

3) * WELL 113–17, 113–16 IS LOCATED APPROXIMATELY 300 FEET SOUTH OF CROSS SECTION LINE E–E'.

4) 105–66, 113–11 PROJECTED ONTO SECTION LINE

\\OERNT\GIS\GW_PROJECTS\MIDDLE ROAD\FIG 2.DWG

BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

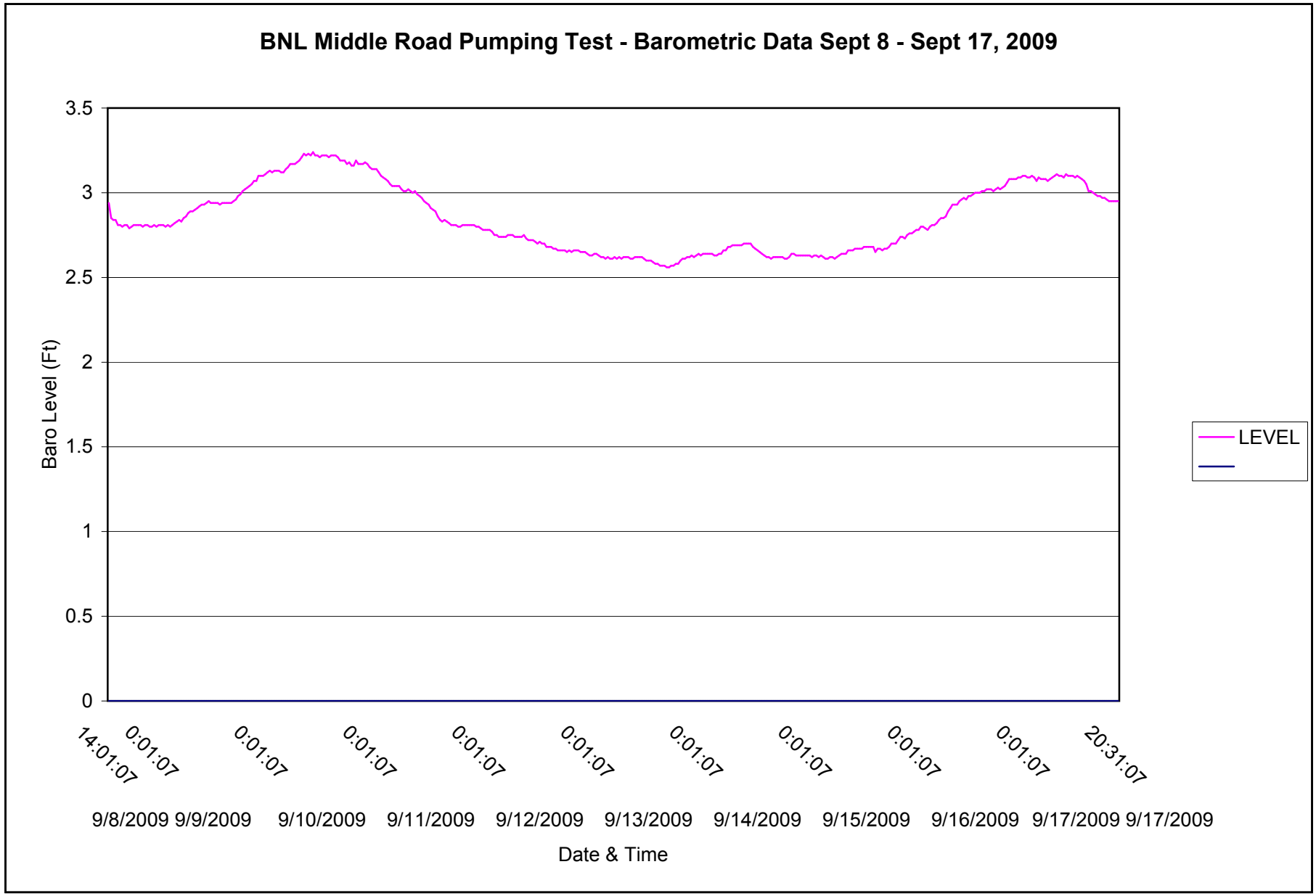
TITLE:

OU III MIDDLE ROAD WEST TO EAST TVOC HYDROGEOLOGIC CROSS SECTION

RW–2 MIDDLE ROAD PUMP TEST REPORT – SEPT. 2009

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	5:1	01/20/10	–
CHKD:	APPD:	REV.:	NOTES:
JRH	–	–	–

FIGURE NO.: 2


BNL Middle Road Pumping Test - Barometric Data Sept 8 - Sept 17, 2009
3.5
3
2.5
2
1.5
1
0.5
0
Baro Level (Ft)
14:01:07
0:01:07
0:01:07
0:01:07
0:01:07
0:01:07
0:01:07
0:01:07
0:01:07
0:01:07
20:31:07
9/8/2009
9/9/2009
9/10/2009
9/11/2009
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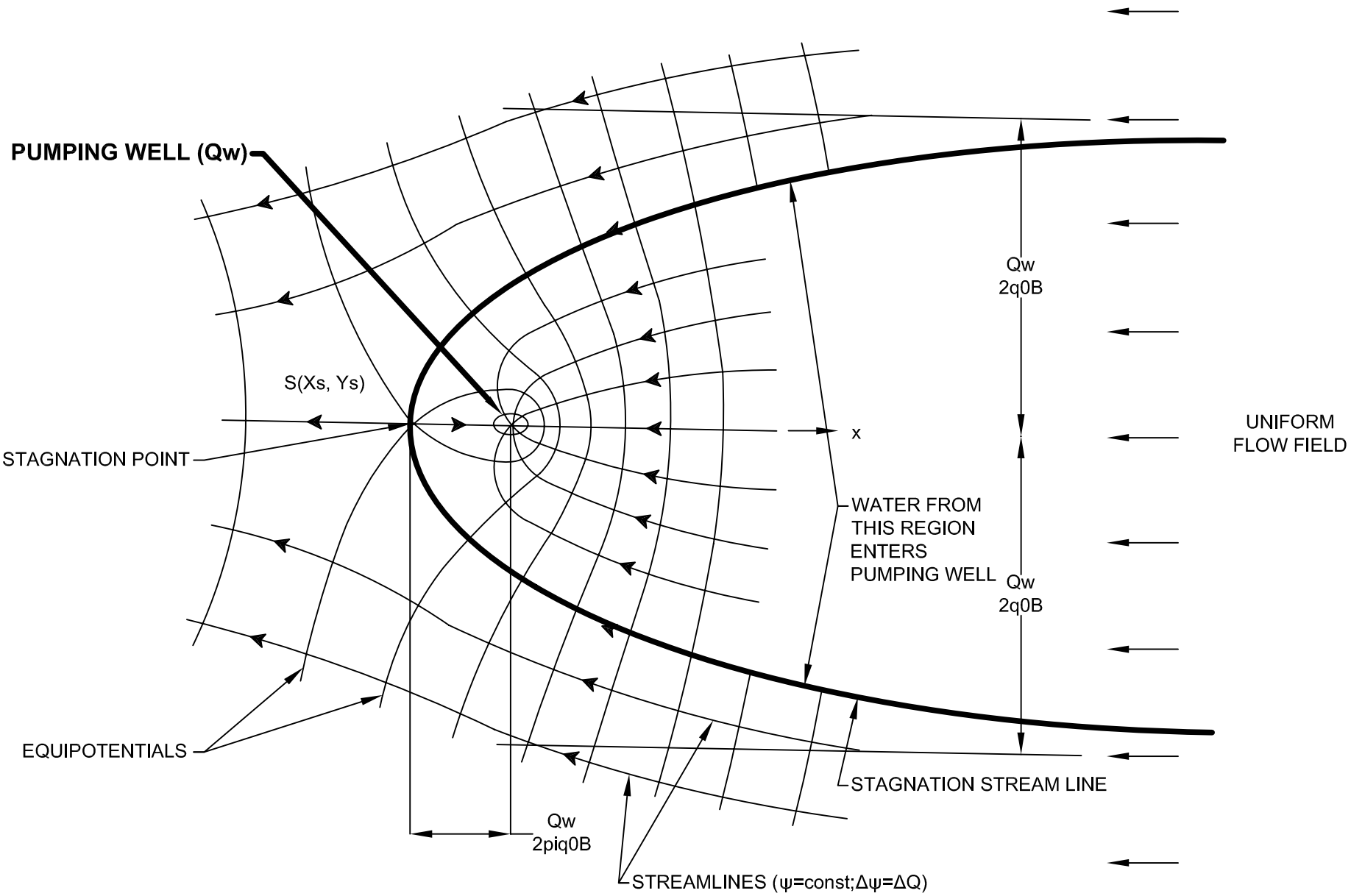
9/17/2009
Date & Time
LEVEL

Figure 3



ADAPTED FROM JACOB BEAR, HYDRAULICS OF GROUNDWATER

BROOKHAVEN NATIONAL LABORATORY

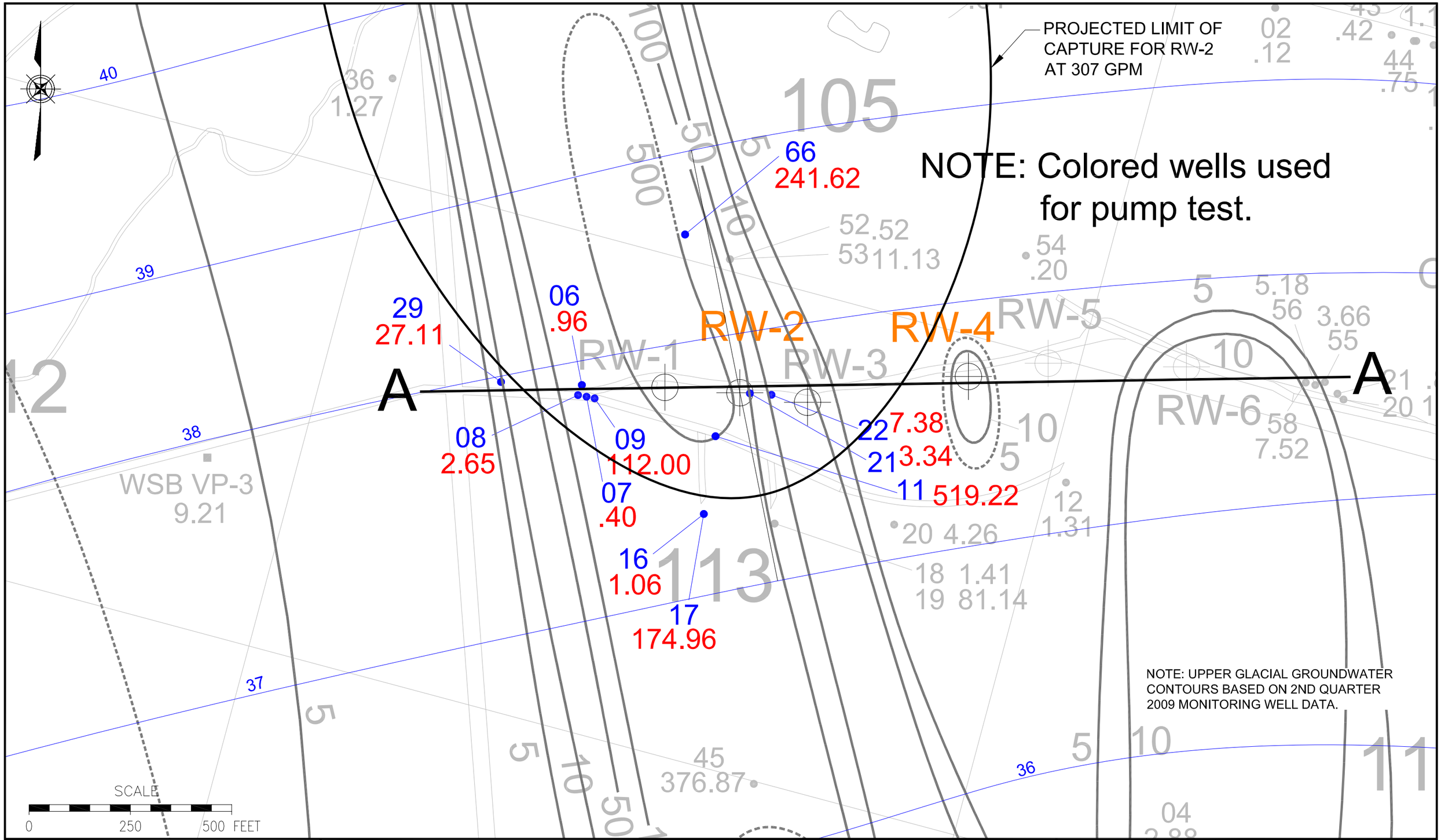
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III MIDDLE ROAD
PUMP TEST, STEADY STATE PUMPING WELL IN UNIFORM FLOW FIELD

RW-2 MIDDLE ROAD PUMP TEST REPORT - SEPT. 2009

DWN:	SCALE:	DATE:	PROJECT NO.:
DGH	N.T.S.	01/20/10	Task 052
CHKD:	APPD:	REV.:	NOTES:
JRH	JRH	-	-
FIGURE NO.:			
4			



BROOKHAVEN NATIONAL LABORATORY

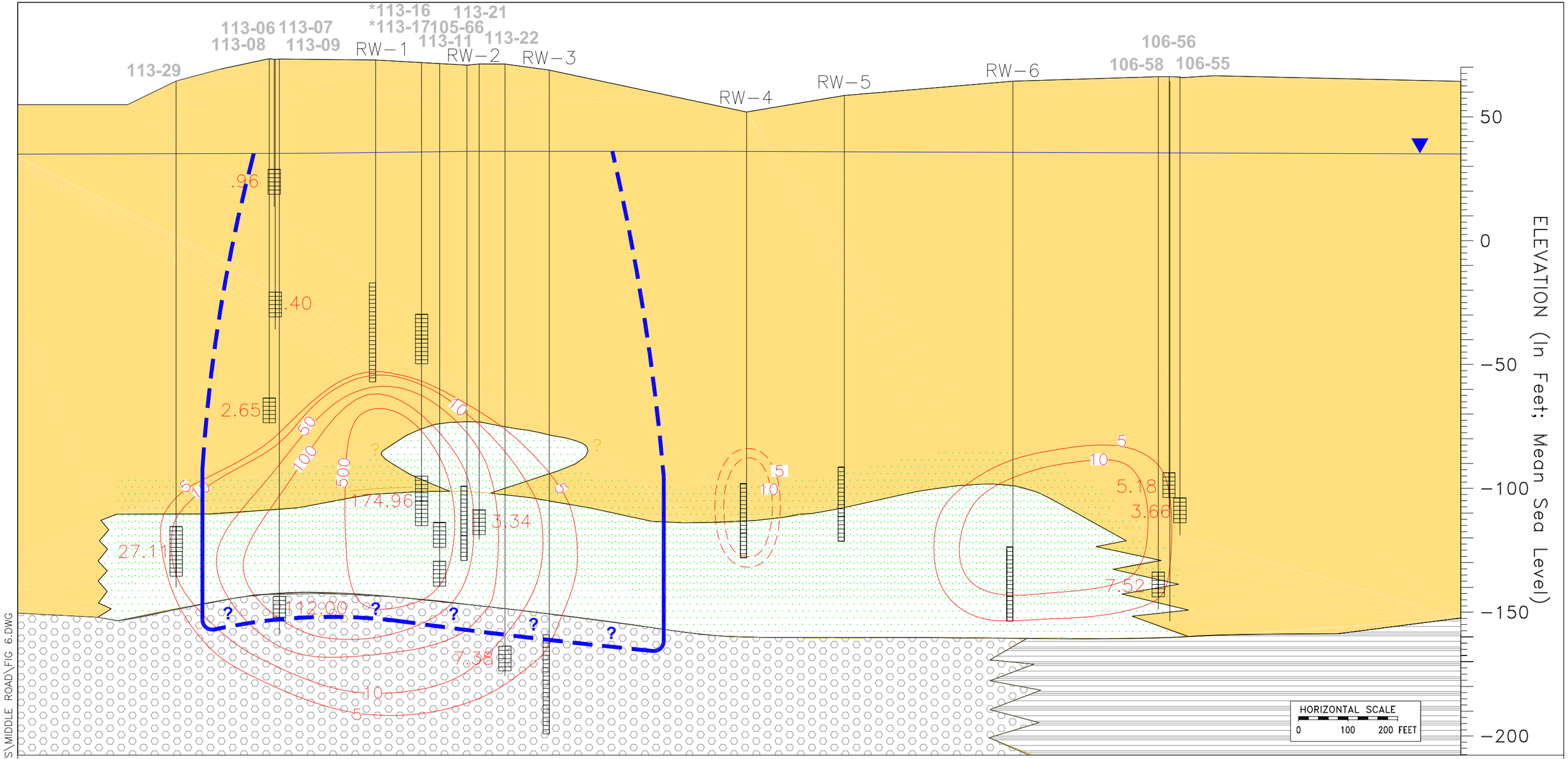
ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III MIDDLE ROAD
PUMP TEST, PROJECTED CAPTURE ZONE

RW-2 MIDDLE ROAD PUMP TEST REPORT – SEPT. 2009

DWN: AJZ	SCALE: AS SHOWN	DATE: 01/20/10	PROJECT NO.: –
CHKD: JRH	APPD: –	REV.: –	NOTES: –
FIGURE NO.: 5			



Upper Glacial aquifer
- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay
- GL Gardiners Clay
- GS Gardiners Clay – Silt

Magothy aquifer
- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undifferentiated)

RW–1 Extraction Well

113–06 BNL Well ID

1.84 TVOC Concentration (µg/L)

5 TVOC Contour (µg/L) (Dashed Where Inferred)

Water Table As Of November 17–21, 2008

Monitoring Well Screen

Extraction Well Screen

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NOTES:

1) GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, MORE DETAILED REPORTS.

2) PLUME DISTRIBUTION BASED ON FOURTH QUARTER 2008 OU III SAMPLING EVENTS.

3) * WELL 113–17, 113–16 IS LOCATED APPROXIMATELY 300 FEET SOUTH OF CROSS SECTION LINE E–E'.

4) 105–66, 113–11 PROJECTED ONTO SECTION LINE

\\OERNT\GIS\GW_PROJECTS\MIDDLE ROAD\FIG 6.DWG

BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

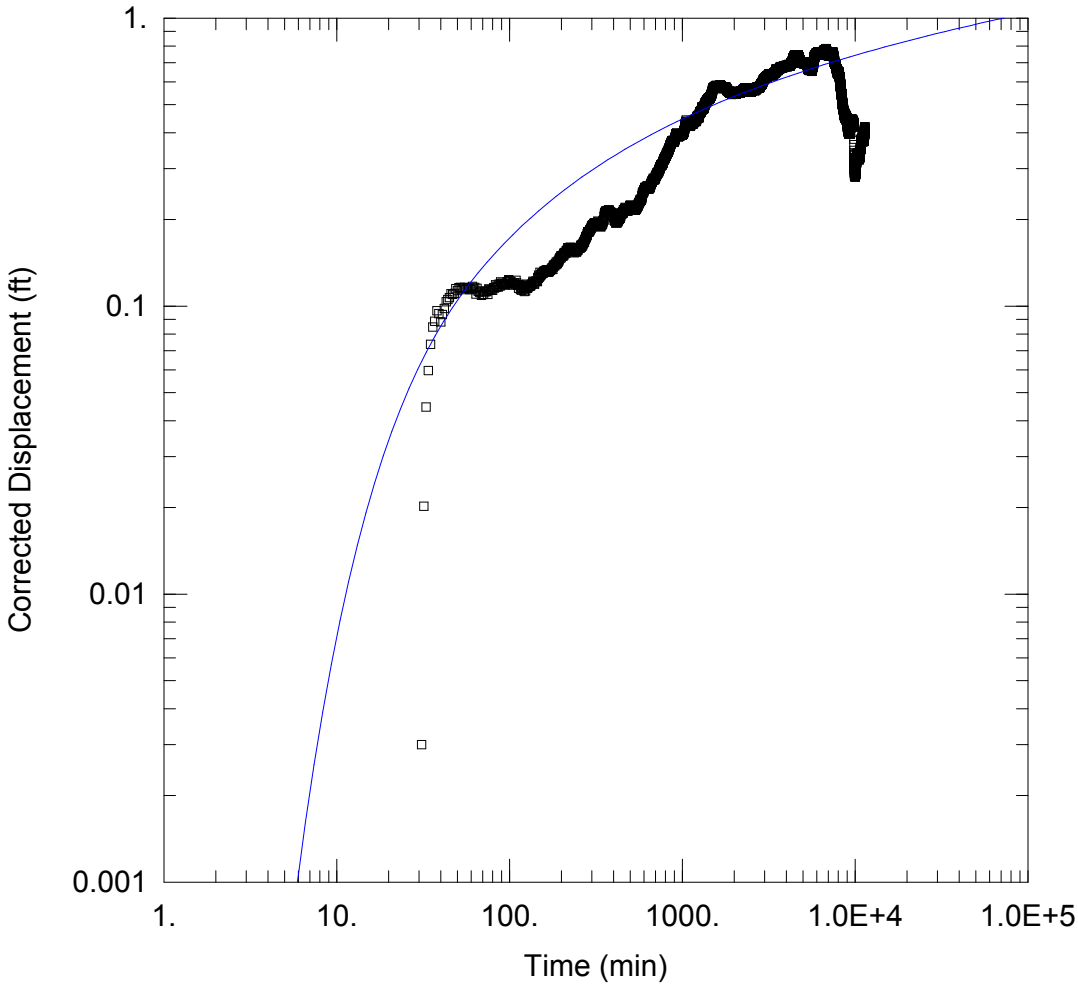
TITLE:

OU III MIDDLE ROAD PREDICTED EXTENT OF RW–2 CAPTURE AT SECTION LINE A–A

RW–2 MIDDLE ROAD PUMP TEST REPORT – SEPT. 2009

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	5:1	01/20/10	–
CHKD:	APPD:	REV.:	NOTES:
JRH	–	–	–
FIGURE NO.:			
6			

“Leveloggers”
Water Level Plots



WELL TEST ANALYSIS

Data Set: C:\...\105-66.aqt
Date: 12/10/09 Time: 14:31:31

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

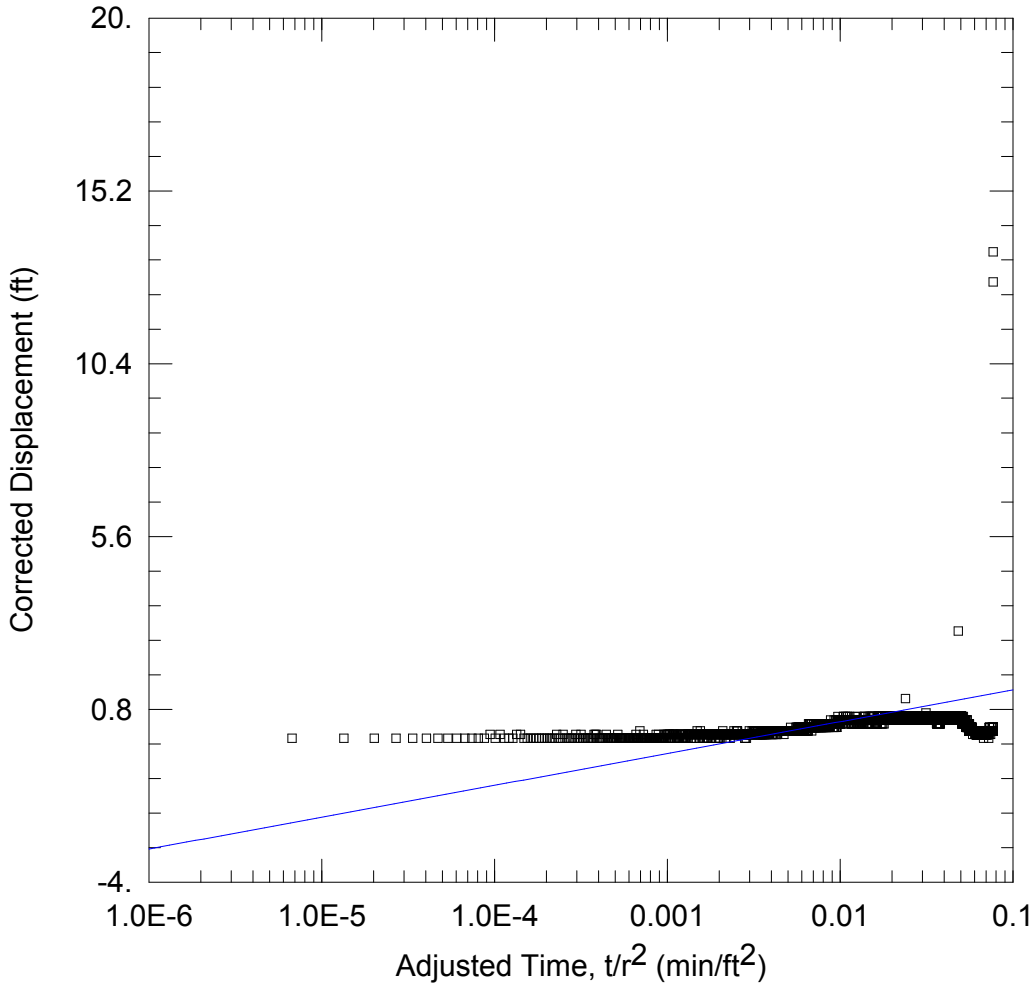
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 105-66	0	413

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 3.535E+4 ft^2/day
S = 0.0136
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\113-07.aqt
Date: 12/10/09 Time: 14:57:11

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

AQUIFER DATA

Saturated Thickness: 200. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

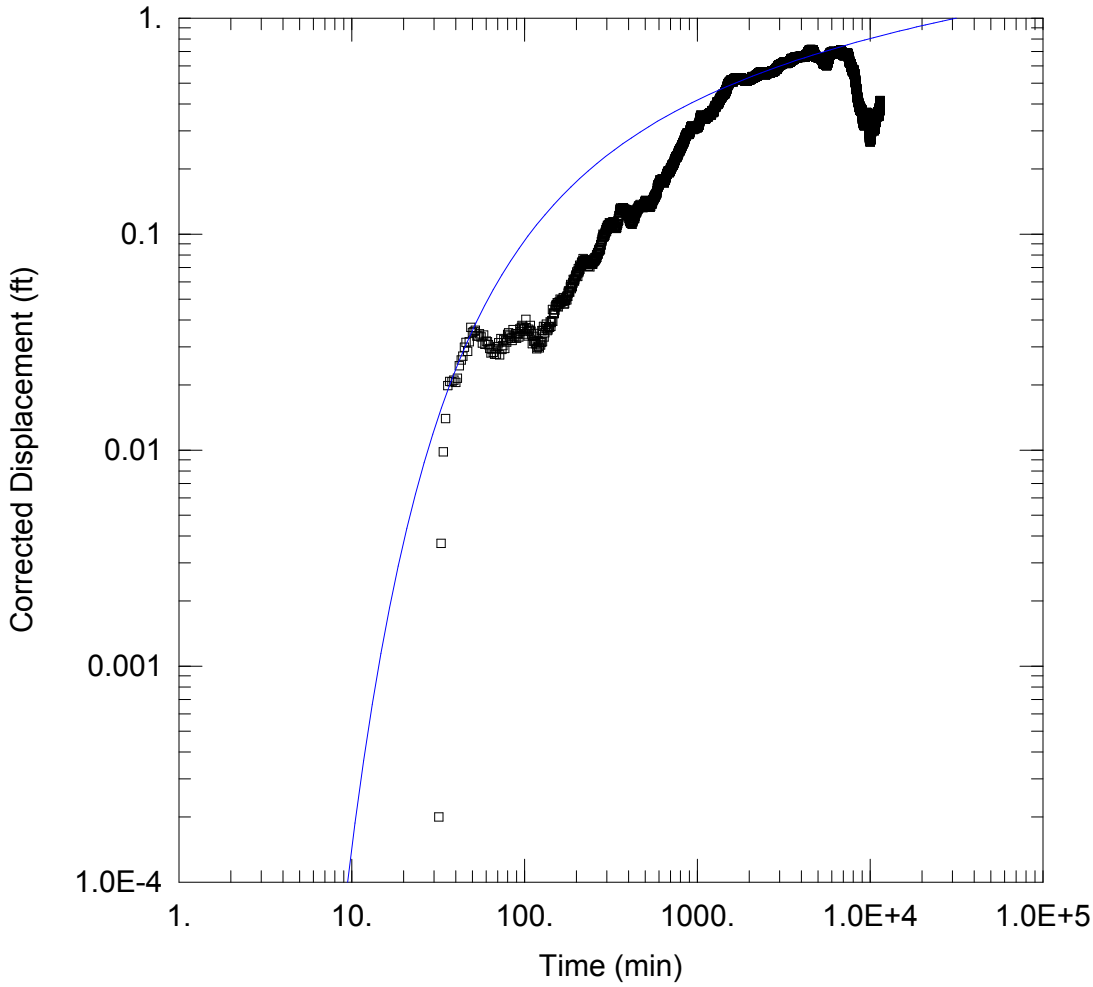
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-07	0	385.4

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 1.225E+4 ft^2/day S = 0.0586



WELL TEST ANALYSIS

Data Set: C:\...\113-08.aqt
Date: 12/10/09 Time: 15:21:35

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

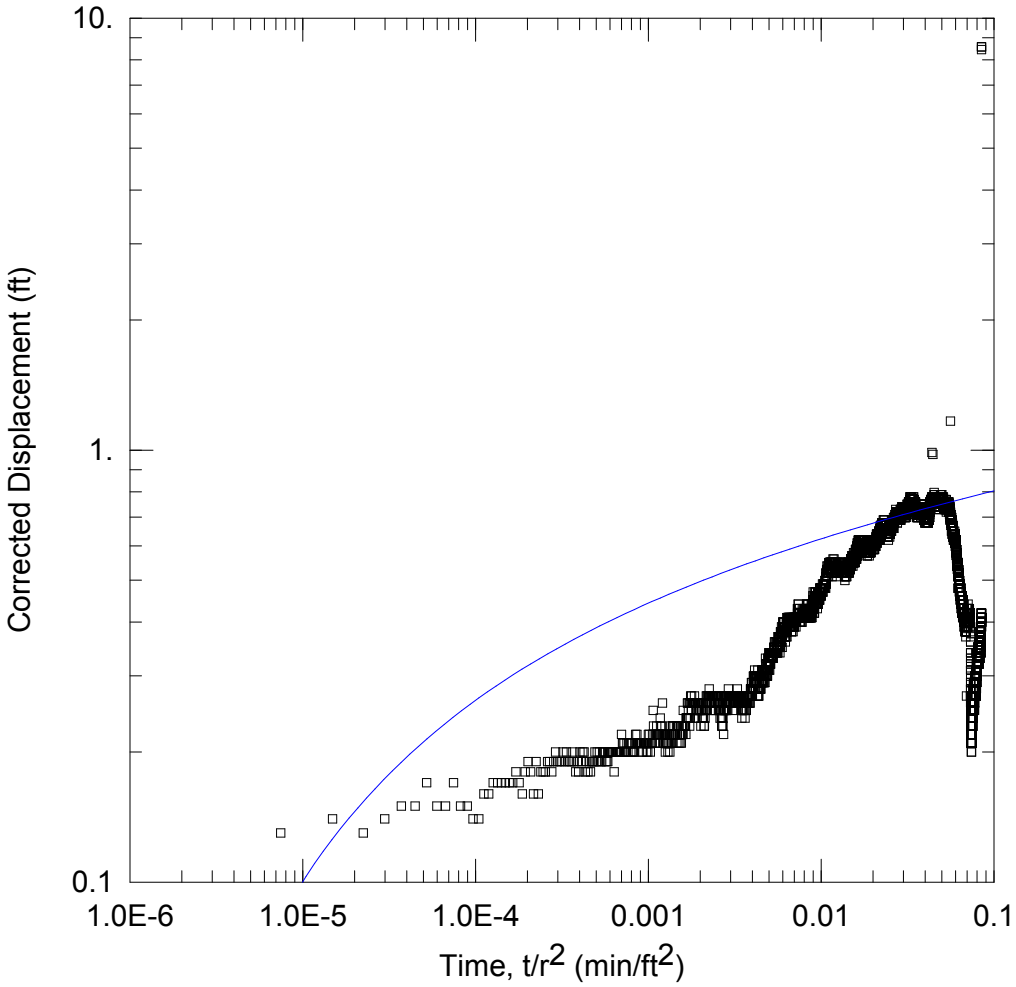
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-08	0	406

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 2.745E+4 ft^2/day
S = 0.02444
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\113-09.aqt
Date: 12/10/09 Time: 15:35:51

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

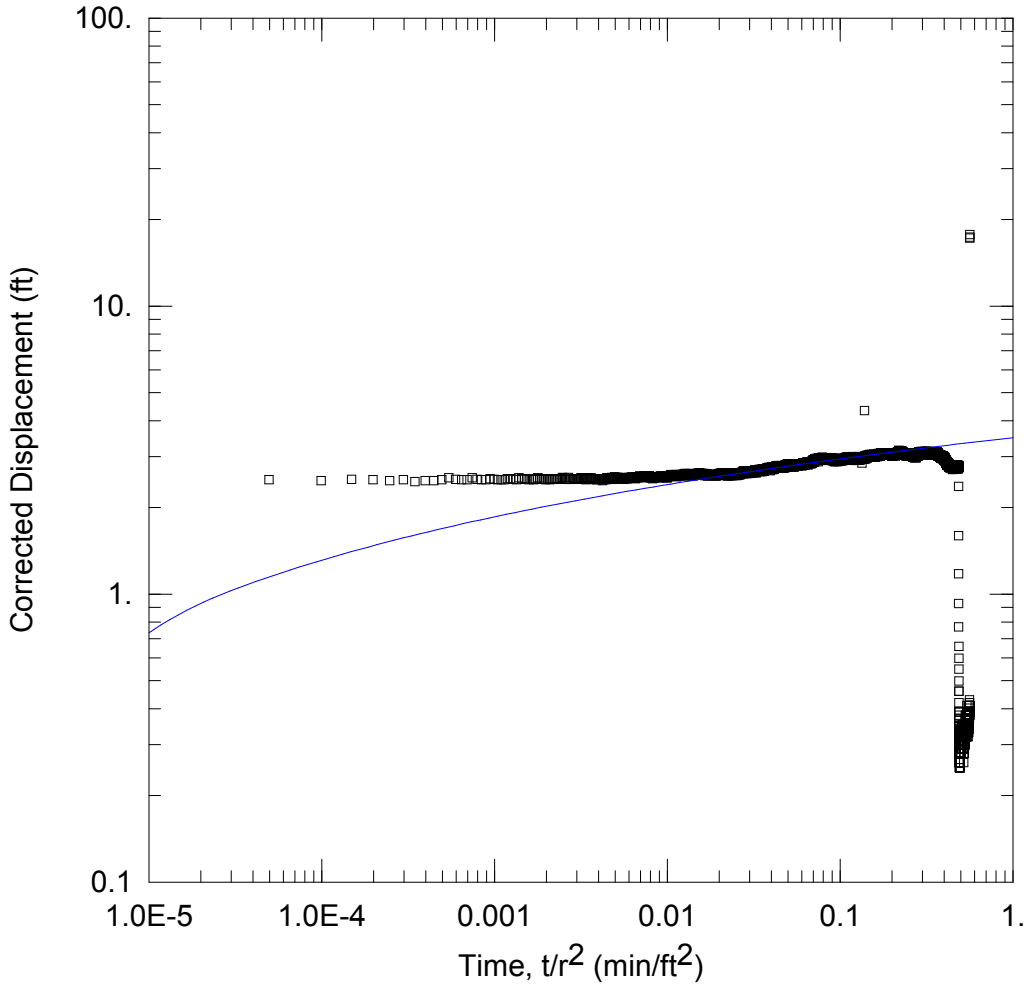
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-09	0	366

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 5.982E+4 ft^2/day
S = 0.0004948
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\113-11.aqt
Date: 12/10/09 Time: 15:50:30

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

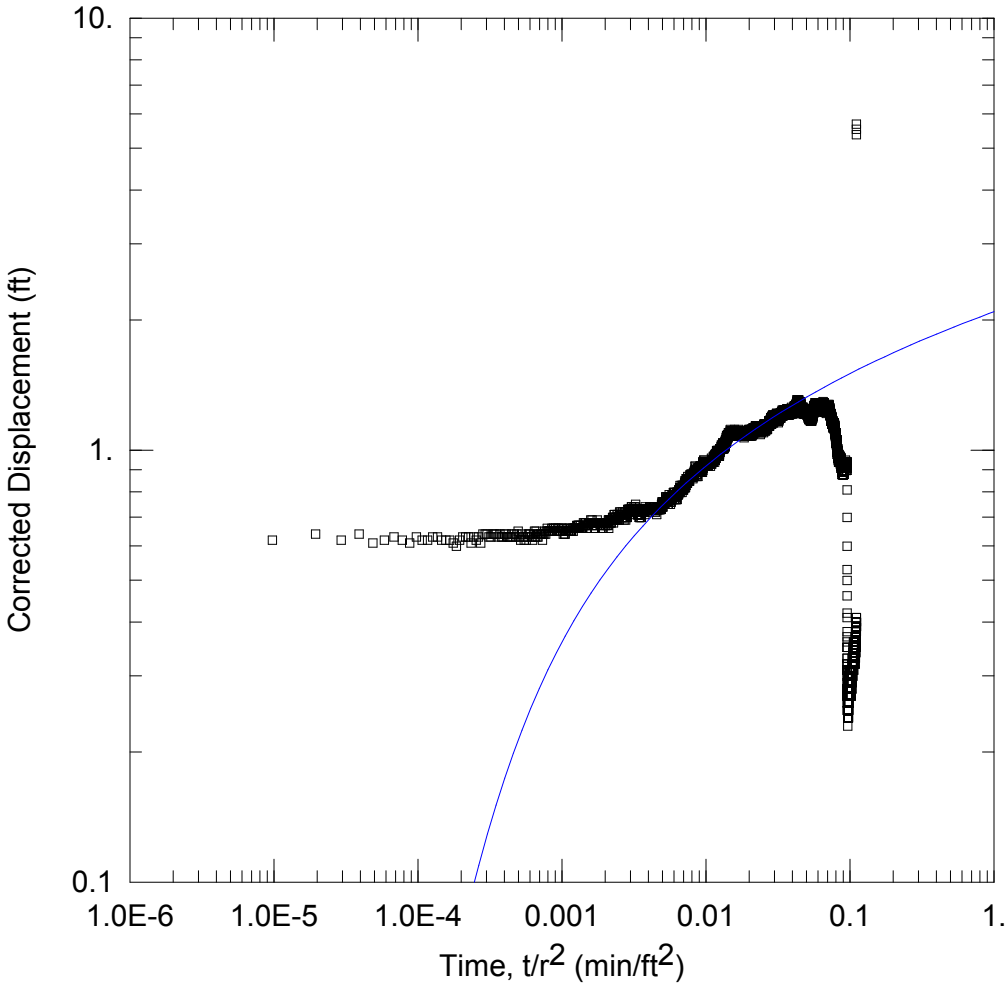
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-11	0	142

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 1.983E+4 ft^2/day
S = 6.669E-5
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\113-16.aqt
Date: 12/10/09 Time: 16:05:18

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

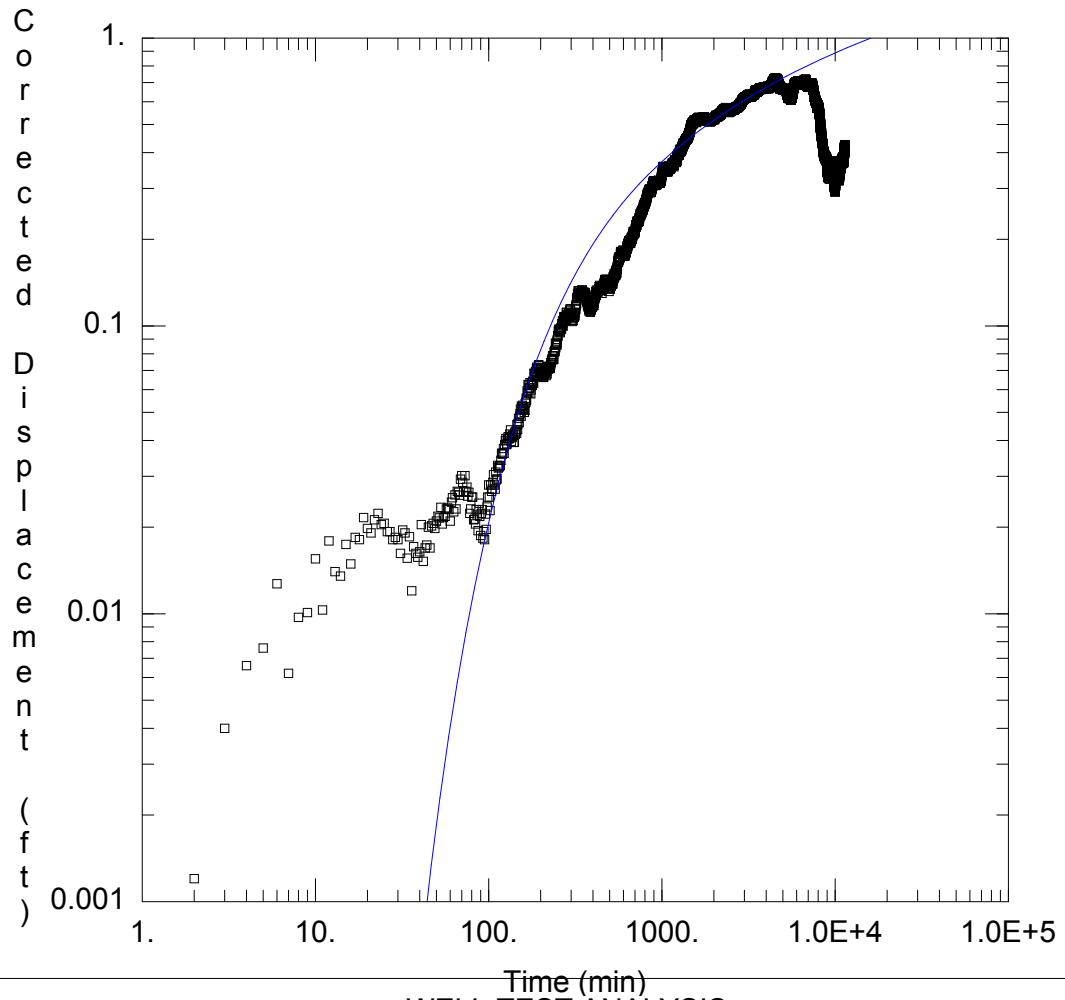
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-16	0	320

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 1.844E+4 ft^2/day
S = 0.006418
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\Program Files\Solinst\Levelogger3_0\data\BNL Mid Rd PT\113-17.aqt
Date: 12/15/09 Time: 13:48:56

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

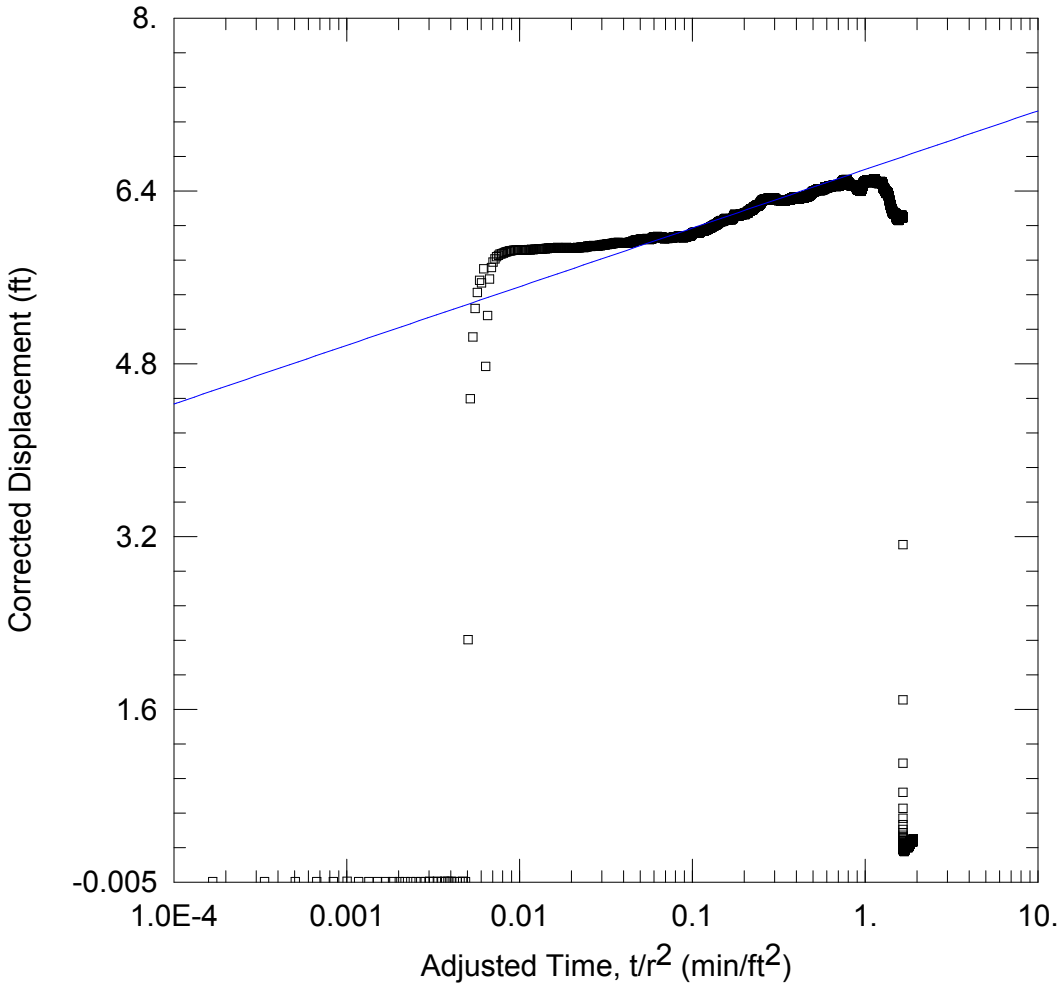
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-17	0	311.9

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 1.95E+4 ft^2/day
S = 0.1145
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\113-21.aqt
Date: 12/10/09 Time: 16:20:13

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

AQUIFER DATA

Saturated Thickness: 200. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

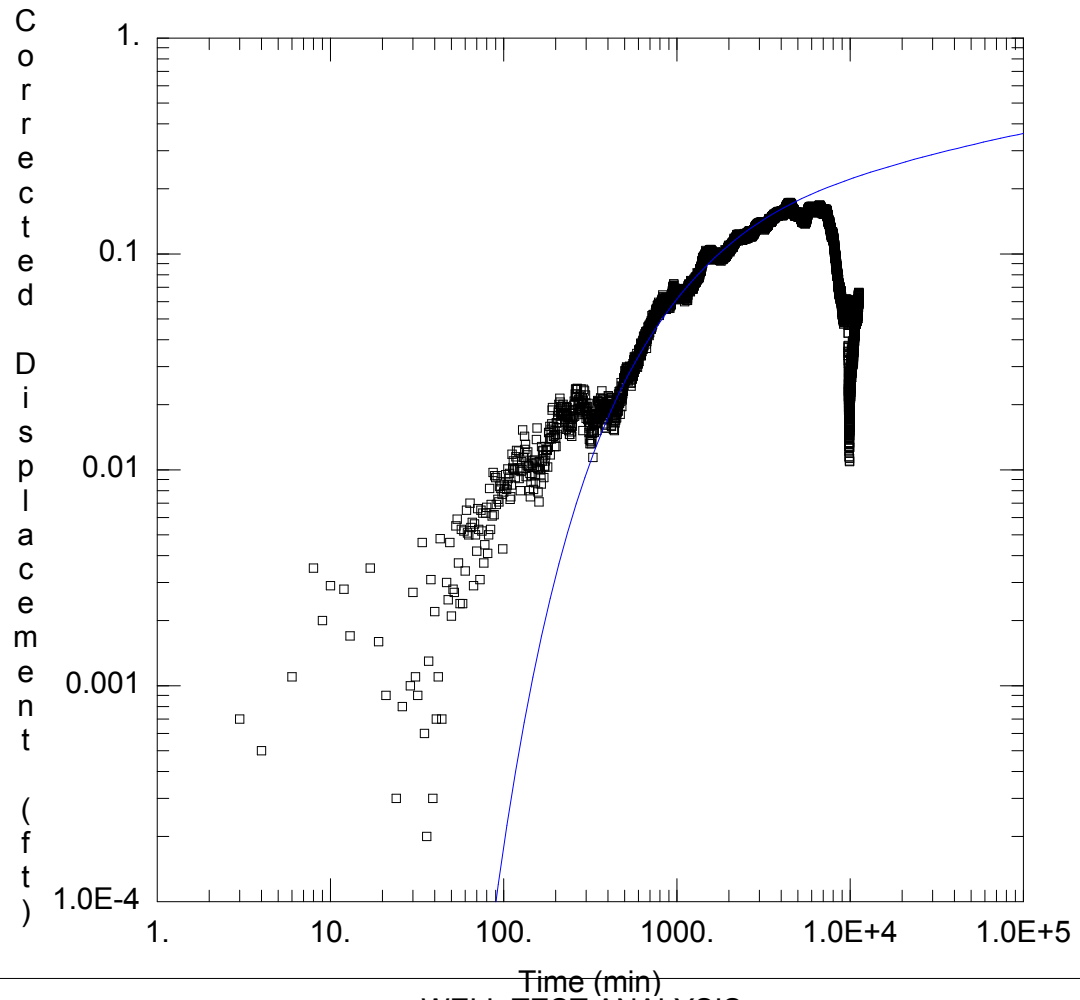
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-21	0	77.2

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 1.994E+4 ft^2/day S = 2.218E-11



WELL TEST ANALYSIS

Data Set: C:\Program Files\Solinst\Levelogger3_0\data\BNL Mid Rd PT\113-22.aqt
Date: 12/15/09 Time: 13:32:01

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

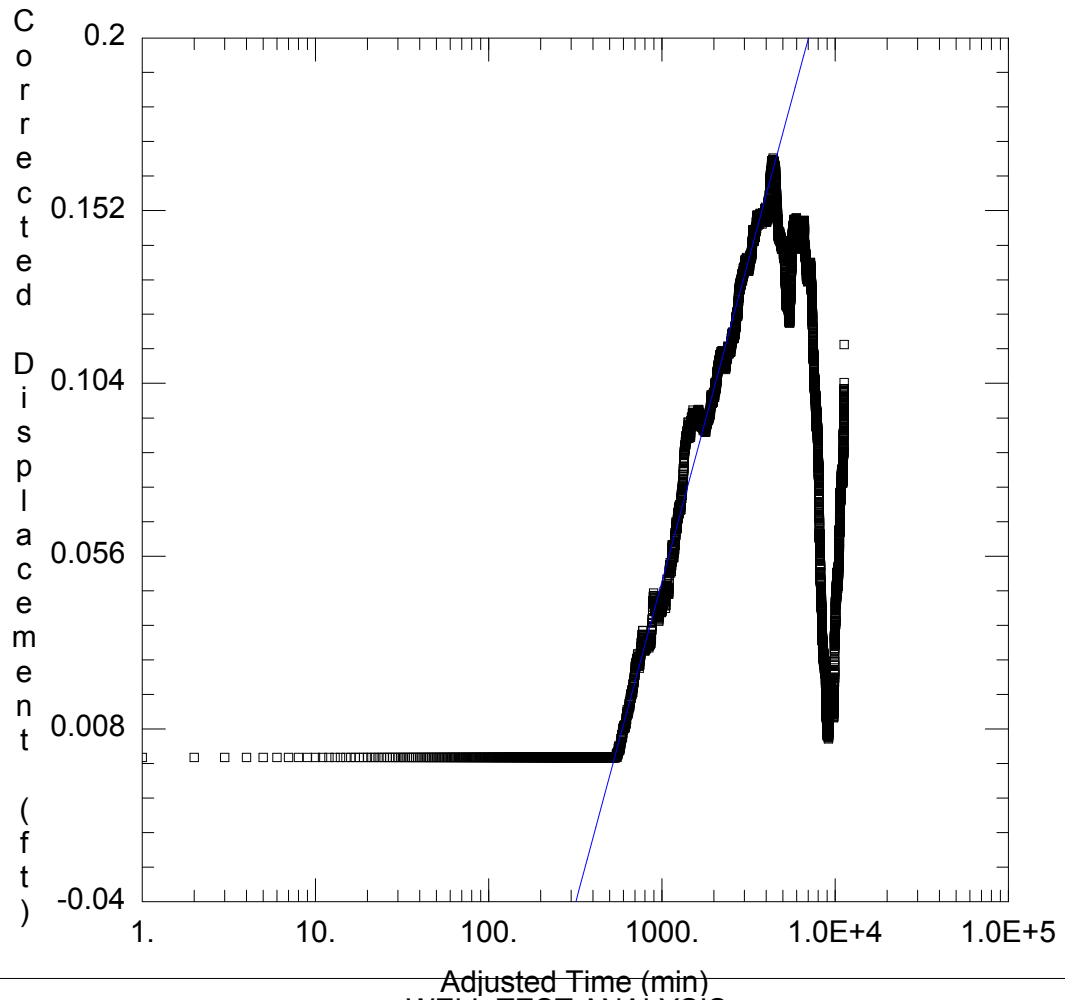
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-22	0	107.4

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 7.774E+4 ft^2/day
S = 3.447
Kz/Kr = 0.1
b = 235. ft



WELL TEST ANALYSIS

Data Set: C:\...\113.29.aqt
Date: 12/15/09 Time: 13:37:09

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

AQUIFER DATA

Saturated Thickness: 250. ft Anisotropy Ratio (Kz/Kr): 0.5418

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

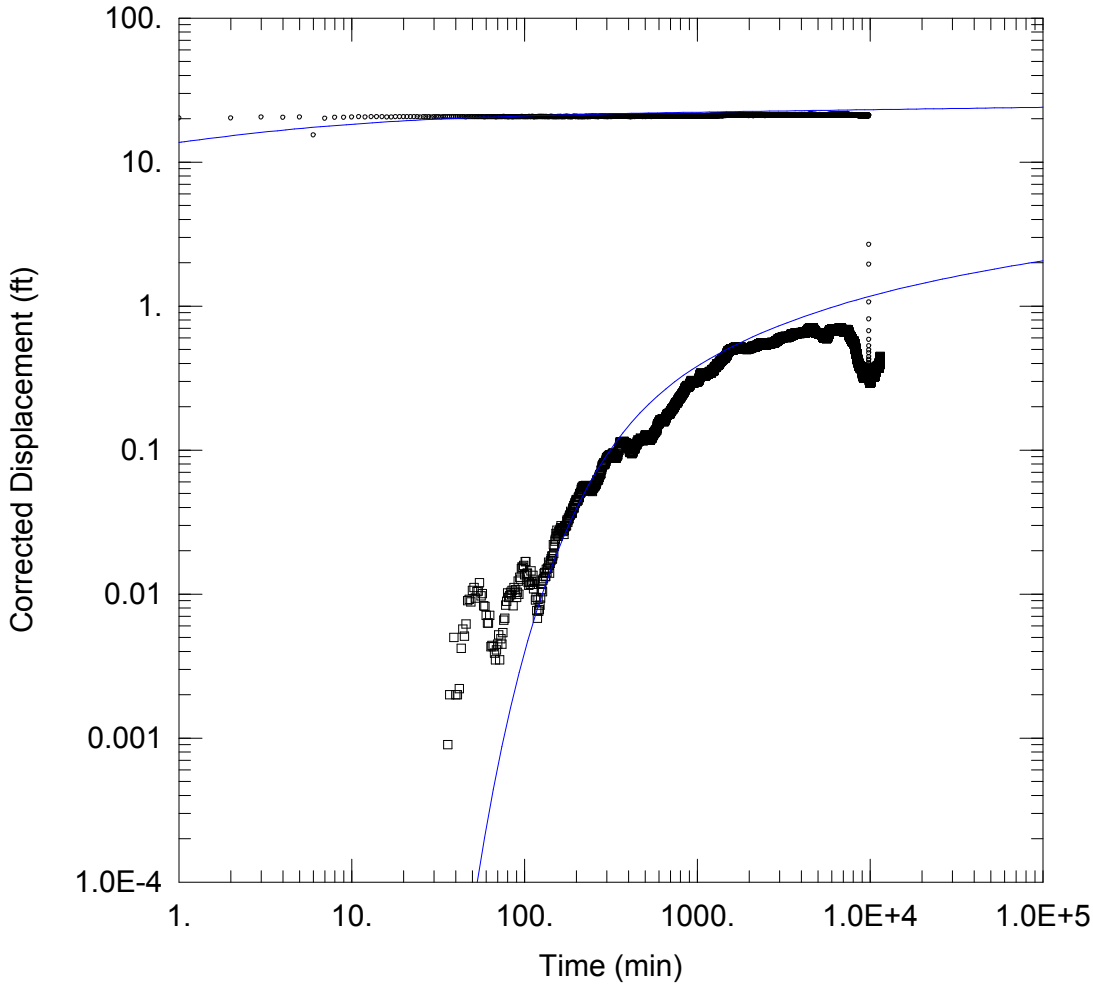
Observation Wells

Well Name	X (ft)	Y (ft)
▫ 113-29	0	589.7

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 6.058E+4 ft^2/day S = 0.1451



WELL TEST ANALYSIS

Data Set: C:\...\Aqtw4.aqt
Date: 12/10/09 Time: 13:31:44

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

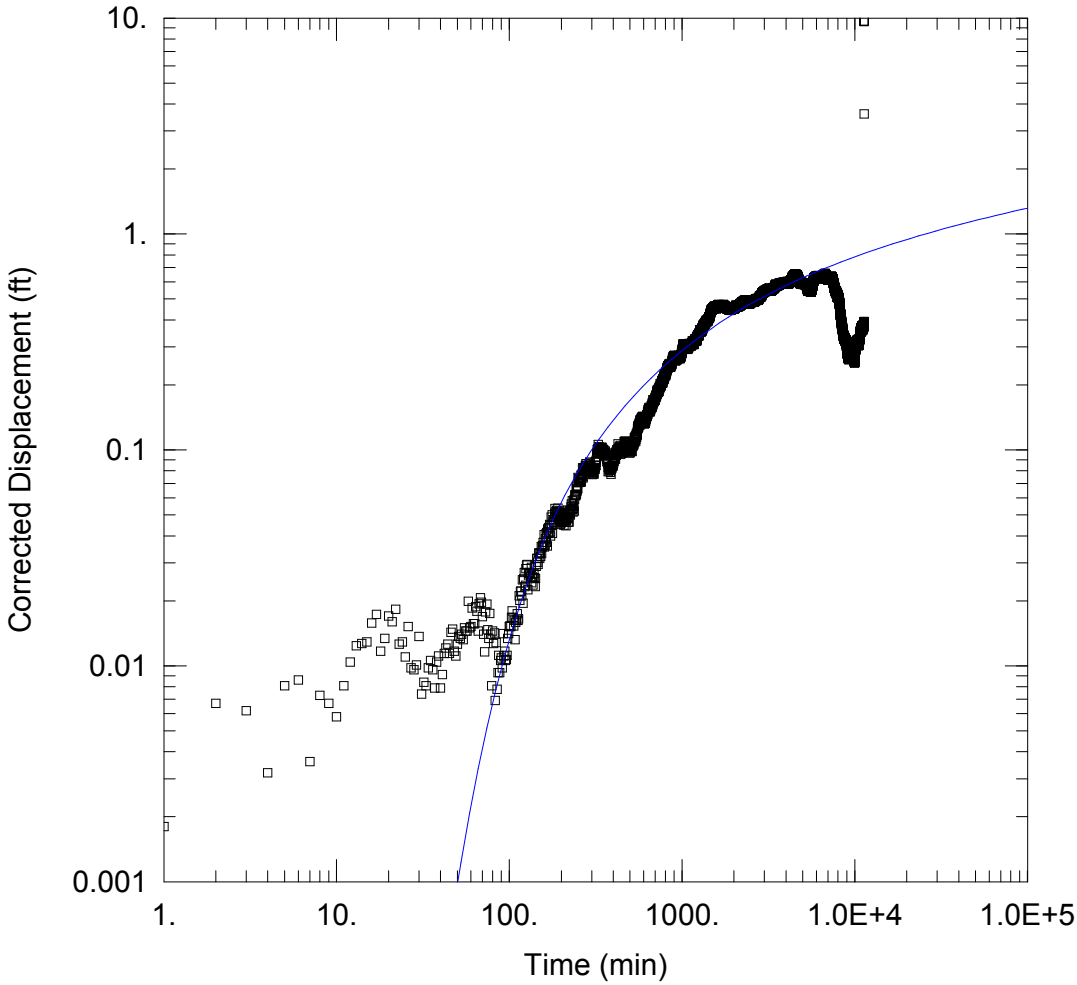
Observation Wells

Well Name	X (ft)	Y (ft)
◦ RW-2	0	0
□ 113-06	0	397

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 1.173E+4 ft^2/day
S = 0.07809
Kz/Kr = 0.1
b = 200. ft



WELL TEST ANALYSIS

Data Set: C:\...\RW-4.aqt
Date: 12/10/09 Time: 14:18:07

PROJECT INFORMATION

Company: JR Holzmacher
Client: BNL
Location: Middle Road
Test Well: RW-2
Test Date: Sept.10, 2009

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
RW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ RW-4	0	565.4

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 1.968E+4 ft^2/day
S = 0.03728
Kz/Kr = 0.1
b = 200. ft