

ATTACHMENT H

Pump Test Reports

- 1) Havertown OU3 ROS Area Pumping Test (Seven pages)
- 2) RW-7 Zone of Influence Evaluation (13 pages)
- 3) CW-31D/RW-7 GW Modeling Summary (One page)

Havertown Pumping Test

April 2010

General Scope of Work:

The purpose of the pump test was to determine the approximate sustainable pumping rate available for the capture of contaminated groundwater migrating into the OU3 area, and estimate if that rate will be significant to capture the contamination prior to overtopping or wrapping around the in-place sheet piling. Pumping was performed on one of the six wells in the area (RW-9), with the other 5 wells utilized as observation wells for the duration of the test (RW-8, RW-10, MW-32, MW-33, and MW-34).

Pumping of the well was performed using a Grundfos Redi-Flow 3⁺, powered by a generator. The Redi-Flow pump utilizes an adjustable rate control box to control the pumping rate. To monitor the flow rate, in the discharge line near the final discharge point. The flow rate displayed on the digital flowmeter was compared to timed measurements for filling a five-gallon bucket. Water levels were monitored using the In-Situ Pump Test Kit, which consists of the Virtual Hermit software, 6 Troll pressure transducers, and a Troll hub data center. The software and transducers, when hooked up to a laptop, allowed the employee onsite monitor the drawdown of water from the wells in real time. Water levels were recorded using a water level meter and compared to the transducer collected data to insure that the data collected was accurate.

Flow data was recorded into the field book, as were manually recorded water level readings. Digital data was stored on the pressure transducers (which recorded data regardless of whether the computer was connected) and downloaded to the laptop approximately every 2 hours as a backup measure.

Discharge water from the pump test was collected into an onsite open top tank. A sump pump with an approximate pumping rate of 30 gpm was installed in the tank, and was manually activated when the tank was filled. Discharge water was then pumped through an existing 2" temporary force main to the Havertown Groundwater Treatment Plant. The sump pump was powered by a second generator.

Two testing procedures were performed: 1) a step-test, during which the pumping rate was fluctuated, and 2) a constant rate pumping test. Upon completing both tests, water level data was again collected as the wells recovered (recharged), providing an additional data set to analyze.

Step Drawdown Test Summary

The step drawdown test (step test) was performed on April 20, 2010, during sunny weather conditions. Two Tt employees were onsite: Chris Sollenberger as the geologist performing the test, and Rick Thomas to assist in testing start up. Initial water levels were collected from all six wells prior to the start of testing, after which the pressure transducers were installed in the wells and set up for the days testing. Transducers were set up for manual start via the laptop.

Pumping began at 11:30 AM at a rate of 3.5 gpm, and the rate was increased to the second step of 5.6 gpm at 12:01 PM when the data monitored on the laptop indicated that drawdown had slowed down

and appeared to be at a steady state. During the next step pumping rate was increased to 5.6 gpm. This pumping rate drew down the water table to near the pump at around 12:30 PM. At this time, it was determined due to the rapid drawdown in the pumping well at this rate, it would be beneficial for data collection to allow the aquifer to recover and then re-start the test after full recovery.

The wells recovered in approximately 30 minutes, at which point the pump was started at 10 gpm for the third step. At 10 gpm the well drew down to the pump intake in 8 minutes. After this interval, the well was allowed to recover again to the initial water level, and was pumped again at 5 gpm. The water level drew down to the well in approximately 20 minutes, and was allowed to continue pumping as long as water was visibly discharging to the tank. During the duration of pumping while the water level was near the pump, water would alternately discharge and stop throughout the duration, with no indication of completely stopping to discharge. Pumping for the step test was ended at 2:30 PM on April 20, 2010.

Based upon the step test results a pumping rate of 3 pm was selected as the rate for the constant rate pumping test to be conduct on the following day.

Pump Test Summary

The constant rate pump test was performed on April 21, 2010, with sunny weather in the morning changing to light showers around 12:30 PM and eventually steady rain starting around 4:30 PM. Two Tt employees were onsite: Chris Sollenberger as the geologist performing the test, and Rick Thomas to assist in testing start up. Prior to the start of the test, water levels were recorded from each of the wells. Based on the results of the step test, it was determined that a 12 hour pump test would provide better data than the previously planned 8 hour pump test data. It was also decided that the pumping rate would be increased at the 8 hour point of the test from 3 gpm to 5 gpm.

Pumping began at 8:07 AM, and continued until 8:07 PM. The pumping rate was increased at 4:07 PM. The pumping rate was monitored and recorded at regular intervals, alternating between the water level meter and timing the filling of a bucket. Water levels were recorded until approximately 4:30 PM, when the rain became steady and notes were starting to run while being recorded. A temporary canopy was erected during the rain to insure that the equipment would be protected and to provide cover for onsite employees. Water levels were recorded from the completion of the test until the following day.

At the 8-hour point the pumping rate was increased to 5 gpm. At this rate the water level quickly drew down to near the well intake. Pumping was continued for the duration of the 4 hour period to determine if there would be a point where the aquifer would become drained below the ability of the pump to lift out of the well.

Recovery and Decontamination:

Data collection was completed on April 22, 2010. Two employees, Chris Sollenberger and Rick Thomas, were onsite to shut down data collectors, download the data, decontaminate equipment, and ship equipment back to the supplier. Final water levels were collected, and indicated that the wells had

recovered completely. After the data was downloaded from the pressure transducers and the transducers were deactivated, all equipment was removed from the wells.

Equipment which had been exposed to groundwater was removed from each well and placed on plastic near the well. All equipment was then washed with detergent and then rinsed with clean water over a tub to collect all wash/decon water from the equipment. Afterwards the equipment was placed on clean plastic until it was dried by hand. All equipment was shipped back to its supplier the day it was removed from the well.

Analysis:

Data analysis was performed utilizing the AQTESOLV software package. The data package includes techniques to determine aquifer characteristics using a wide variety of calculations, including; Theis, Cooper-Jacob, and Neuman, among others. The data package can also calculate draw down and recovery tests, as well as single and multiple well tests. A series of basic parameters for the aquifer and well were included.

The basic assumptions were:

- The wells are fully penetrated in the aquifer.
- The aquifer is approximately 20 feet thick.
- The aquifer is unconfined.
- The recovery wells have a 4 inch diameter.
- The monitoring wells have 2 inch diameter.

Prior to analysis, the data collected from the transducers had to be reduced to several files which included only the times and the depths to water, as well as removing the additional data collected (Temperature and Pressure). After this reduction was performed, the data could then be imported into Aqtesolv. Several iterations and calculations were run on the pump test data and the step test data, as well as available recovery data.

Results:

The advantage of utilizing the Aqtesolv package is the ability to quickly analyze the data a variety of ways without having to re-enter data. Based on the information obtained from the pumping and step tests, three of the data were selected for comparison: the data from the 3 gpm pump test, the data from the 5 gpm step of the step test, and the data from the recovery of the 3 gpm pump test. The majority of the other data was eliminated due to the speed at which it pumped to the well and the water level began to oscillate, with variations on the order of 1 to 2 feet in depth to water.

Based on the data, three sets of values were obtained:

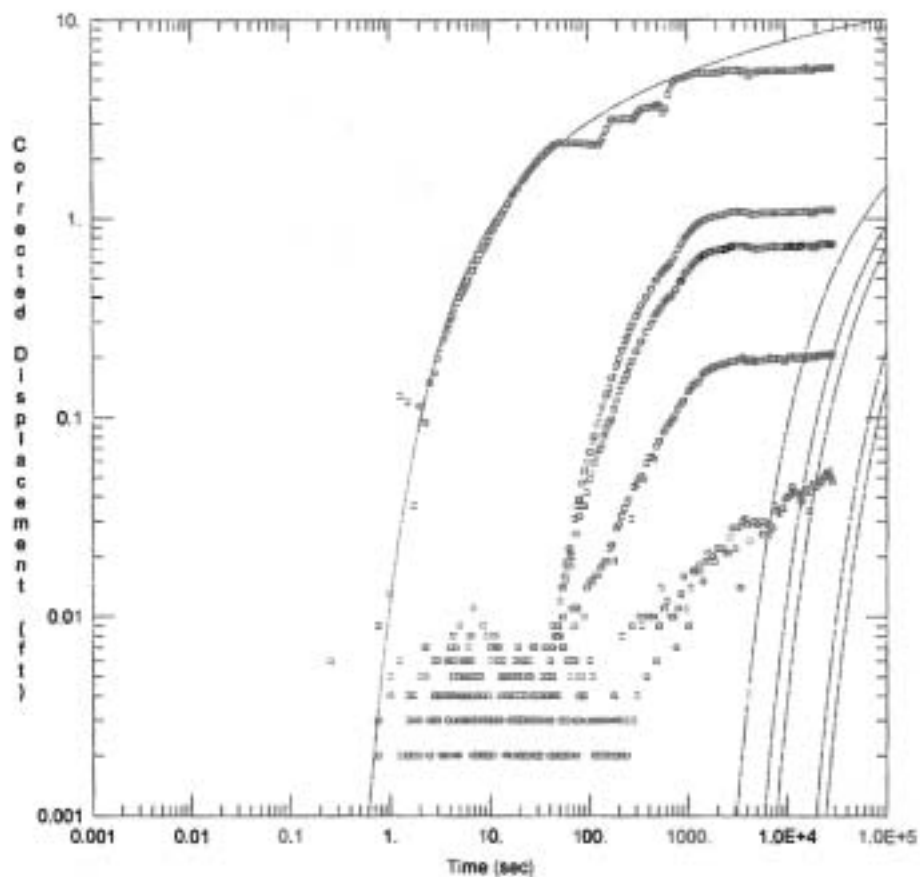
Data Set	Method	Transmissivity In Feet Squared/Day(T)	Storativity (S)	Saturated Thickness in Feet (b)	Hydraulic Conductivity in Feet/Day (K)
3 GPM Pump Test	Theis	44.31	0.05849	20	2.216
3 GPM Recovery	Neuman	47.1	0.05184	20	2.355
5 GPM Step Test	Neuman	11.47	0.06745	20	0.574

Copies of the drawdown and recovery tests curves for the test are attached to this document.

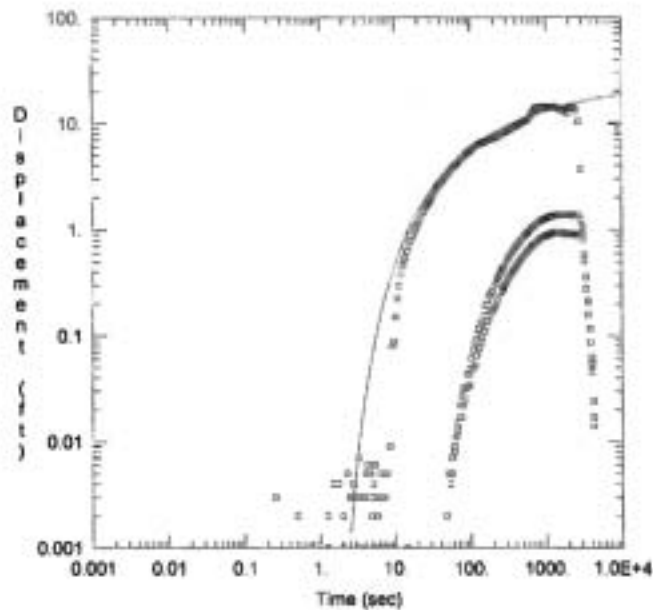
Conclusions:

Based on the data obtained, it appears as though there are a variety of conditions prevalent in the ROS area that might affect flow to the new recovery wells . The 5 GPM Step Test Data demonstrated a very different transmissivity in comparison with the 3 GPM pump test; however, the 5 GPM step was performed after the day of step testing in the ROS area, and may represent the conditions after the overlaying porous soils have been drained by continuous pumping.

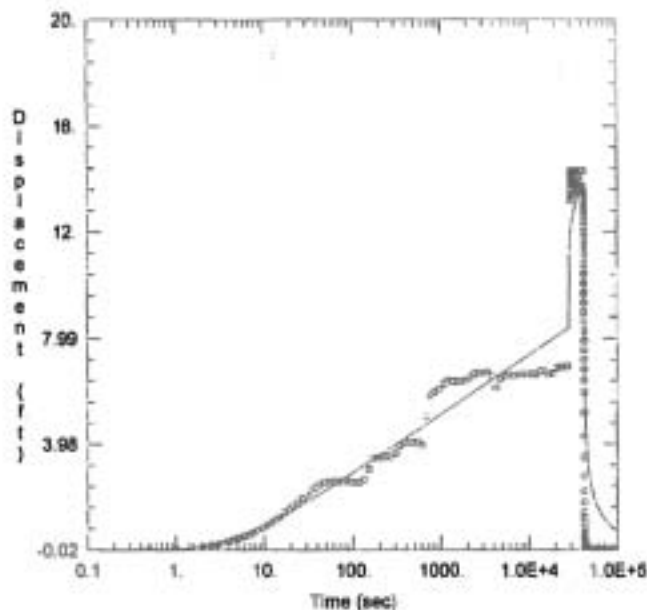
Based on the data obtained and the analysis performed, it appears as though the pumps previously specified as part of the OU3 Basis of Design will be sufficient to extract water from the OU3 ROS area. It appears as though 3 gpm is a sustainable rate for extraction, though a higher rate may be possible for a shorter duration. Groundwater modeling would be a potentially useful tool to determine a precise rate of extraction from this area to assist with developing a recovery well pump cycling program that will maintain capture of shallow groundwater from the site.



WELL TEST ANALYSIS					
Data Set: K:_Havertown Pump Test 3 gpm.egt			Time: 14:17:59		
Date: 05/03/10					
PROJECT INFORMATION					
Company: Tetra Tech N/S, Inc.					
Client: EPA					
Project: 112G02188					
Location: Havertown, PA					
Test Well: RW-9					
Test Date: 4/21/10					
WELL DATA					
Pumping Wells			Observation Wells		
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)
RW-9	643	681	RW-9	643	681
			RW-10	654	702
			RW-8	613	688
			CW-32	698	731
			CW-34	658	715
			CW-33	689	658
SOLUTION					
Aquifer Model: Unconfined			Solution Method: Theis		
T = 44.31 ft ² /day			S = 0.05649		
Kz/Kr = 0.1			b = 20. ft		



WELL TEST ANALYSIS					
Data Set: K.L. Havertown Step Test 5 gpm Neuman apt			Date: 05/03/10 Time: 14:18:37		
PROJECT INFORMATION					
Company: Tetra Tech NUS, Inc.					
Client: EPA					
Project: 112002188					
Location: Havertown, PA					
Test Well: RW-9					
Test Date: 4/21/10					
AQUIFER DATA					
Saturated Thickness: 20, ft					
WELL DATA					
Pumping Wells			Observation Wells		
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)
RW-9	643	881	= RW-9	643	881
			= RW-10	654	702
			= RW-8	613	888
SOLUTION					
Aquifer Model: Unconfined			Solution Method: Neuman		
T	= 11.47 ft ² /day		S	= 0.06745	
Sy	= 0.5		Kz/Kr	= 14.89	



WELL TEST ANALYSIS						
Data Set: <u>K1_Havertown Pump Test RecoveryNeuman.aqt</u>						
Date: <u>05/03/10</u>			Time: <u>14:18:58</u>			
PROJECT INFORMATION						
Company: <u>Tetra Tech NUS, Inc.</u>						
Client: <u>EPA</u>						
Project: <u>112002188</u>						
Location: <u>Havertown, PA</u>						
Test Well: <u>RW-9</u>						
Test Date: <u>4/21/10</u>						
AQUIFER DATA						
Saturated Thickness: <u>20 ft</u>						
WELL DATA						
Pumping Wells			Observation Wells			
Well Name	X (ft)	Y (ft)	Well Name	X (ft)	Y (ft)	
RW-9	643	681	= RW-9	643	681	
SOLUTION						
Aquifer Model: <u>Unconfined</u>			Solution Method: <u>Neuman</u>			
T = <u>47.1 ft²/day</u>			S = <u>0.06184</u>			
Sy = <u>0.008397</u>			B = <u>3.072</u>			

**RW-7 Zone of Influence Evaluation
Havertown, Pennsylvania
January 13, 2009**

General

The existing Havertown groundwater model was used to evaluate the influence of pumping well RW-7 on the surrounding aquifer. The extent of the model domain and the general model construction is presented on Figure 1. Pumping test data for RW-7 provided by Tetra-Tech indicated that the previous conceptual understanding of the site hydrogeology did not conform to the results of the RW-7 pumping test. It should also be noted that the RW-7 pumping test was performed in less than ideal conditions: heavy precipitation two days prior to the pumping test likely resulted in elevated water levels in the surface water bodies causing higher than usual recharge in the stream bed locations. For this reason, it was difficult to calibrate the pre-test head elevation provided by Tetra Tech. Average head elevations established during prior modeling tasks were used to develop a pre-test static condition. The static condition is presented on Figure 2.

The RW-7 pumping test results suggest that the fractured bedrock layer of the aquifer reacts differently than the overlying saprolitic layer. Wells with open intervals in the saprolite do not react to the same degree as wells with open intervals in the fractured bedrock layer. Based on the pumping test data, the interface between the saprolitic layer and the fractured bedrock layer exists at a depth of approximately 50 feet below the ground surface. It should be noted that there are some exceptions to this rule. As an example, B-3 has very little reaction to the pumping of RW-7. The formation around this well was not as fractured as the other locations suggesting less hydraulic connection to the aquifer. B-1, a similar distance from the pumping well reacted much faster and had a significant drawdown compared to B-3. Further aquifer definition would be required to more appropriately characterize this formational anomaly.

Model Calibration

Results of the RW-7 pumping test were simulated in the existing Havertown groundwater model. The stressed drawdown from the RW-7 pumping was used as a calibration target. Pumping test data near the end of the test (maximum drawdown) was used as a calibration target. It was assumed that the test reached a steady state condition (equilibrium of drawdown). Model parameters were adjusted to better match the head elevations observed in the surrounding wells. Table 1 and Figure 3 and 4 present the results of the calibration. It should be noted that B-3 was not used in the calibration since this well appeared as an anomaly.

Based on the calibration, it was evident that well B-1 and CW-17D also experienced higher levels of recharge similar to B-3. Numerous sensitivity analyses were conducted to determine the values to use for each of the hydrologic parameters. A very narrow window of parameters allowed the calibration presented on Table 1. Parameters outside these

values resulted in a less accurate quantitative calibration. The key parameters that allowed this calibration are presented on Table 2. As discussed above, due to the conditions that the pumping test was performed, and the nature of fractured bedrock flow, calibration of the RW-7 pumping test data was limited based on the data provided.

The apparent zone of influence of RW-7 alone based on the computed drawdown and the particle tracking is presented on Figure 5 for the saprolitic zone (Model Layer 1) and Figure 6 (Model Layer 2) for the fractured bedrock zone. Based on this simulation, it is apparent that there is a strong anisotropy along the strike of the bedrock. In addition, the zone of influence in the fractured bedrock layer expands outward in a southeasterly direction; however, it is apparent that drawdown occurring in wells CW-19D and CW-18D (as seen in the pumping test) is resulting from the loss of the up-gradient hydraulic head and the actual ability of RW-7 to capture contaminants at these well locations may be limited. It should be noted that there is limited drawdown in the saprolitic layer (Model Layer 1) as presented on Figure 5.

Remedial System Optimum Capture Zone Evaluation

Once a reasonable calibration was achieved, numerous pumping scenarios were simulated in the model to determine the optimum pumping rates for the key recovery wells at the site. The intent was to pump the minimal amount of water and maintain capture of the contaminant plume. Based on the model simulations, the most effective pumping scenario that captured both shallow contaminants and deep contaminants is presented on Figure 7 and Figure 8 (cross sectional view). This involves the trench system (10 gpm), RW-5 (5 gpm), RW-6 (5 gpm), and RW-7 (30 gpm). This pumping scenario captures the entire extent of groundwater contamination with the exception of a small protrusion of the plume in the southeast corner (see Figure 7). Contaminants in this area likely migrate to Naylor's Run.

The pumping scenario discussed above was also evaluated with the injection of water in the up-gradient portion of the contaminant plume. Based on the current groundwater model, wells RW-1, RW-2, and CW-26D can be injected with up to 5.0 gpm each. Higher injection rates begin to limit the effectiveness of the shallow groundwater recovery, pushing contaminants away from the shallow recovery wells in the up-gradient portion of the shallow contaminant plume. Excessive deep injection (above 5.0 gpm) in CW-26D pushes contaminants southward in the bedrock away from the efficient influence of the deep recovery wells.

TABLE 1

Residual Calibration Error
Groundwater Flow Simulation
RW-7 Pumping Test
Havertown, Pennsylvania

Location ID	Observed Head Elevation(ft/msl)*	Computed Head Elevation (ft/msl)	Residual Head Error	Comments
CW-3D	285.82	281.95	3.87	
CW-16D	285.83	287.13	-1.3	
CW-17D	285.17	277.78	7.39	
CW-18D	280.29	281.56	-1.27	
CW-19D	283.18	281.13	2.05	
CW-26D	285.94	286.74	-0.8	
CW-27D	285.86	286.17	-0.31	
CW-28D	285.8	285.17	0.63	
CW-29D	285.9	288.86	-2.96	
B-2 (RW-7)	259.08	259.37	-0.29	
B-1	271.49	264.82	6.67	

Mean of Residual Error -1.240
Mean Absolute Residual Error 2.500
Root Mean Square Error 3.460

* Based on stressed aquifer - RW-7 pumping at 30 gpm (assume steady state).

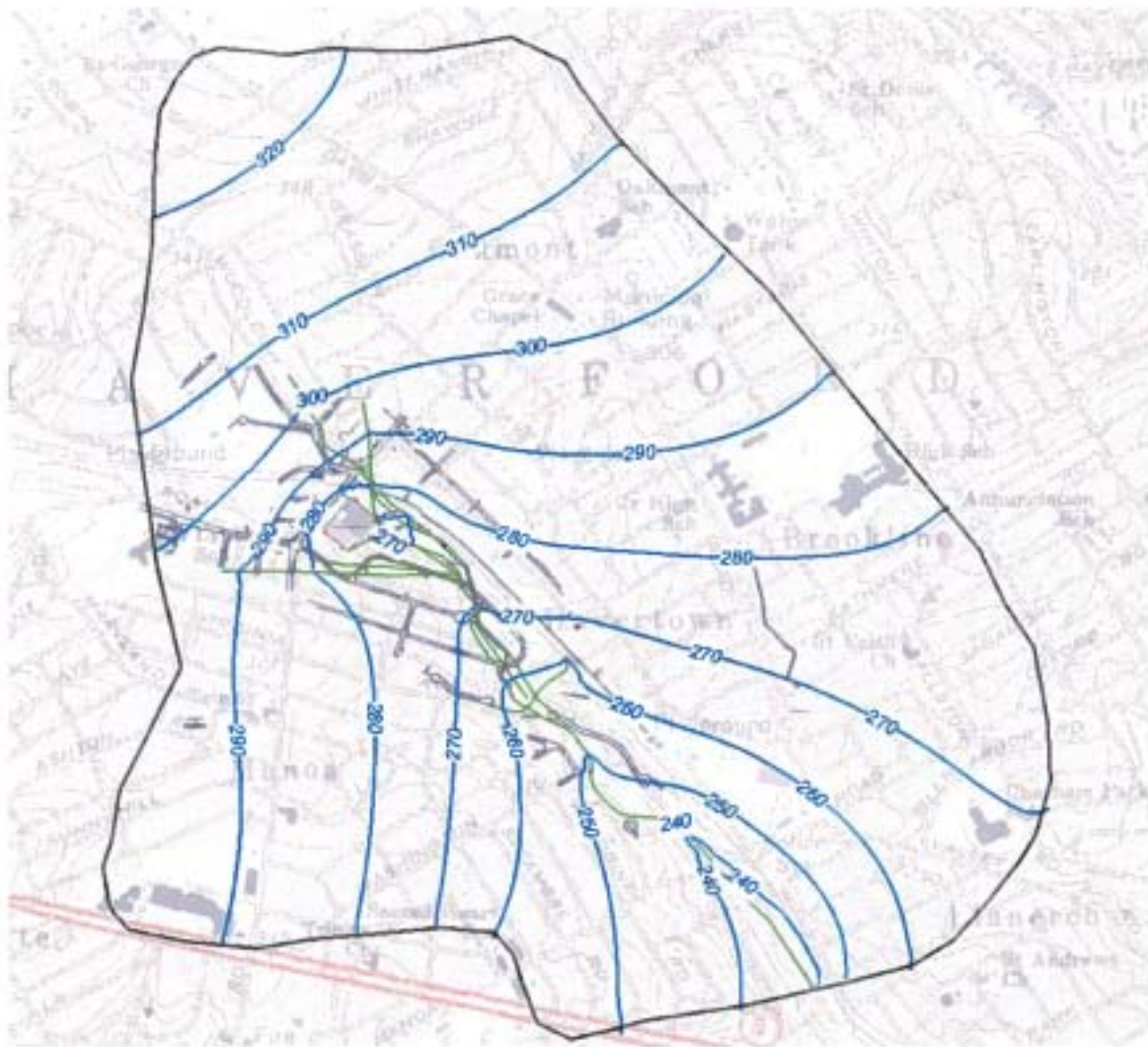
TABLE 2

Hydrogeologic Parameters Used in Model
Havertown Groundwater Model - RW-7 Zone of Influence

Recharge

Recharge Rate (ft/day)	0.0015	(6.57 ft/day)
------------------------	--------	---------------

Hydraulic Conductivity (ft/day)		<i>Horizontal Anisotropy Ratio</i>	<i>Vertical Anisotropy Ratio</i>
Layer 1 (Saprolite)	1.4	1.4	1
Layer 2 (Fractured Bedrock)	0.25	6	1
Layer 3 (Fractured Bedrock)	0.25	2	1
Layer 4 (Less Permeable Bedrock)	0.1	2	1




NOTES:

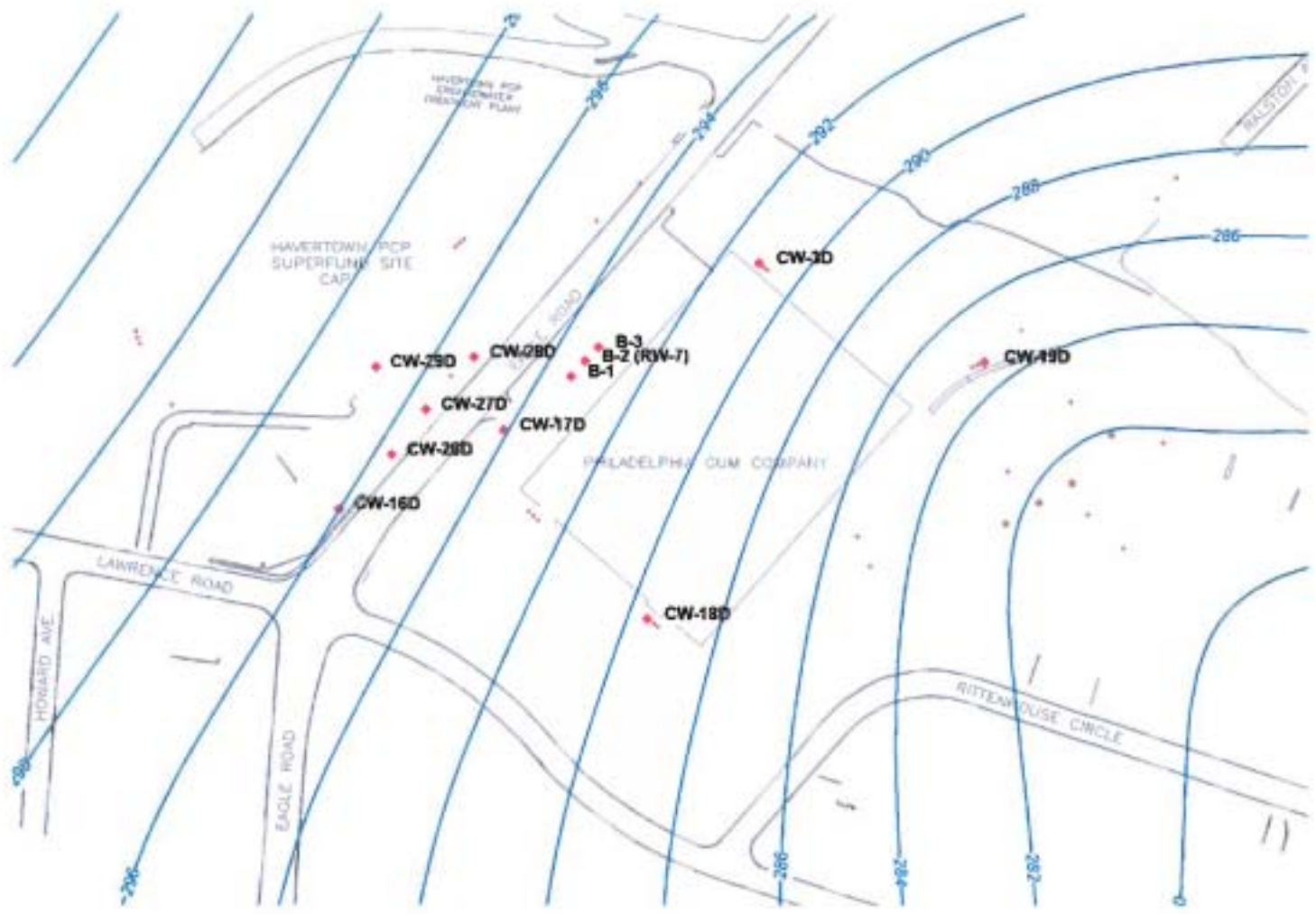
1. NO FLOW ARCS ARE SITUATED ON APPARENT GROUNDWATER DIVIDES BASED ON REGIONAL TOPOGRAPHY. THE NO FLOW ZONE ON THE SOUTH SIDE OF THE SITE IS NOT A GROUNDWATER DIVIDE AND WAS SET FAR ENOUGH FROM THE AREA OF INTEREST TO PREVENT INTERFERENCE.

EXPLANATION:

-  DRAIN ARC (UTILITIES/ATLORS RUN)
-  NO FLOW ARC
-  GROUNDWATER ELEVATION CONTOUR - RW-7 PUMPING CONDITIONS (FEET MSL)



INFORMATIONAL MAP OF THE 		VAL F. BRITTON, P.G.	
PROJECT NO.	DATE	SCALE	BY
DESCRIPTION	DATE	DATE	DATE
DRAWN BY	CHECKED BY	DATE	DATE
EXTENT OF MODEL DOMAIN AND BOUNDARY		RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA	
TITLE		1	



NOTES:

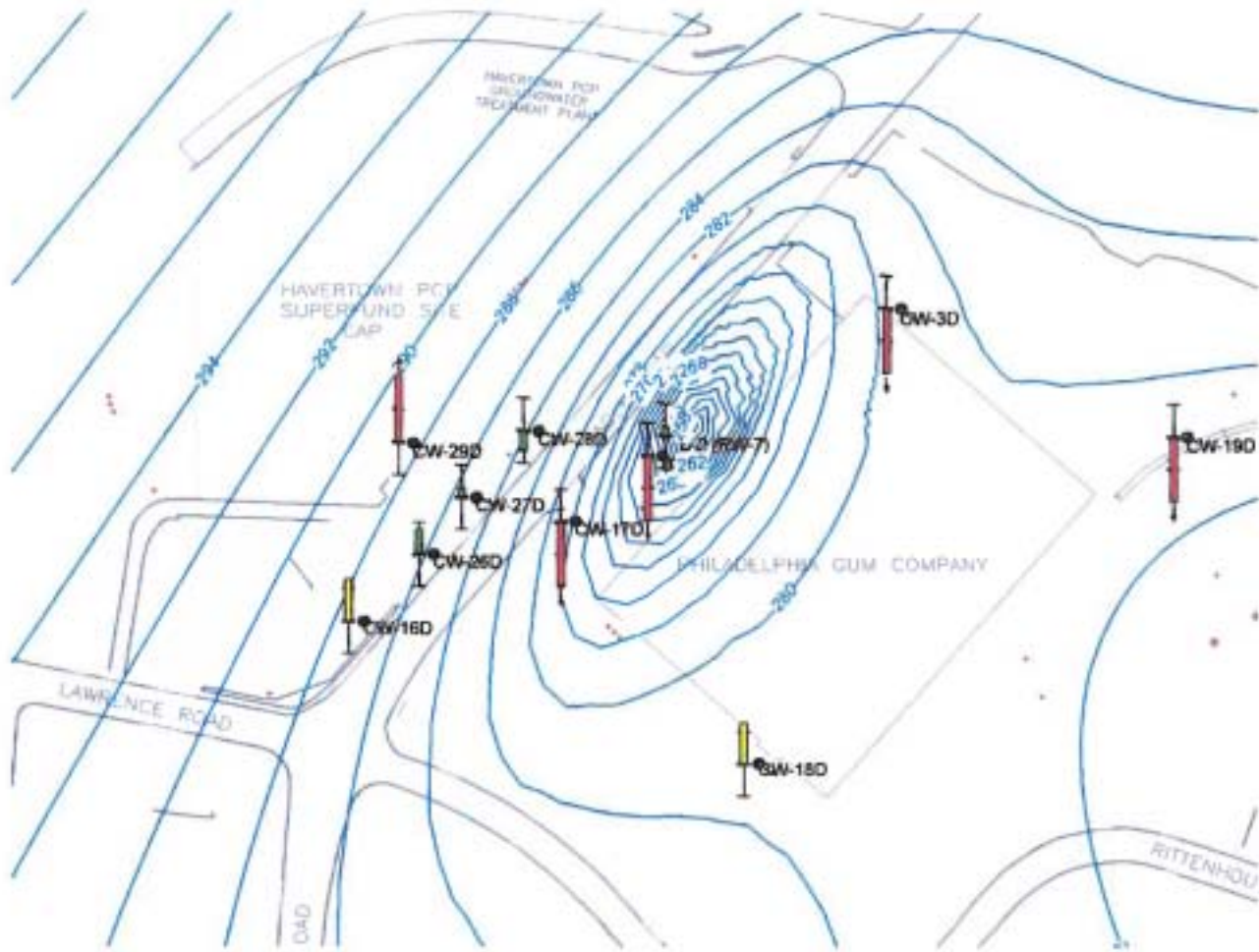
1. STATIC CONDITION IS AN AVERAGE WATER LEVEL FOR THE SITE. PRE-TEST CONDITIONS WERE NOT USED DUE TO SIGNIFICANT PRECIPITATION PRIOR TO THE PUMPING TEST.

EXPLANATION:

— 282 — GROUNDWATER ELEVATION CONTOUR (FEET MSL)



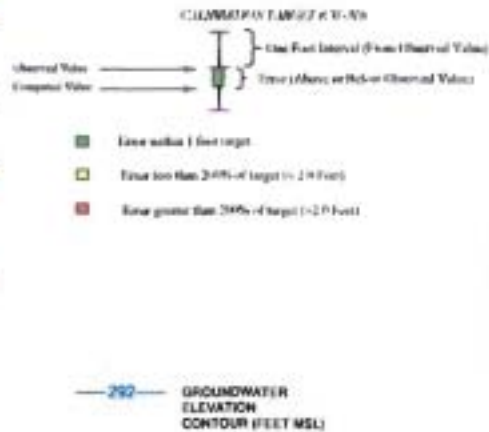
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DESIGNED BY	MA	PLANNED BY	MA
DRAWN BY	WFB	CHECKED BY	WFB
PROJECT TITLE		DATE PLOTTED	
PRE-PUMPING STATIC CONDITIONS		11/14/01	
RW-7 ZONE OF INFLUENCE EVALUATION			
HAVERTOWN, PENNSYLVANIA			
DRAWN BY		DATE PLOTTED	
WFB		11/14/01	
VAL F. BRITTON, P.G.			
2			



NOTES:

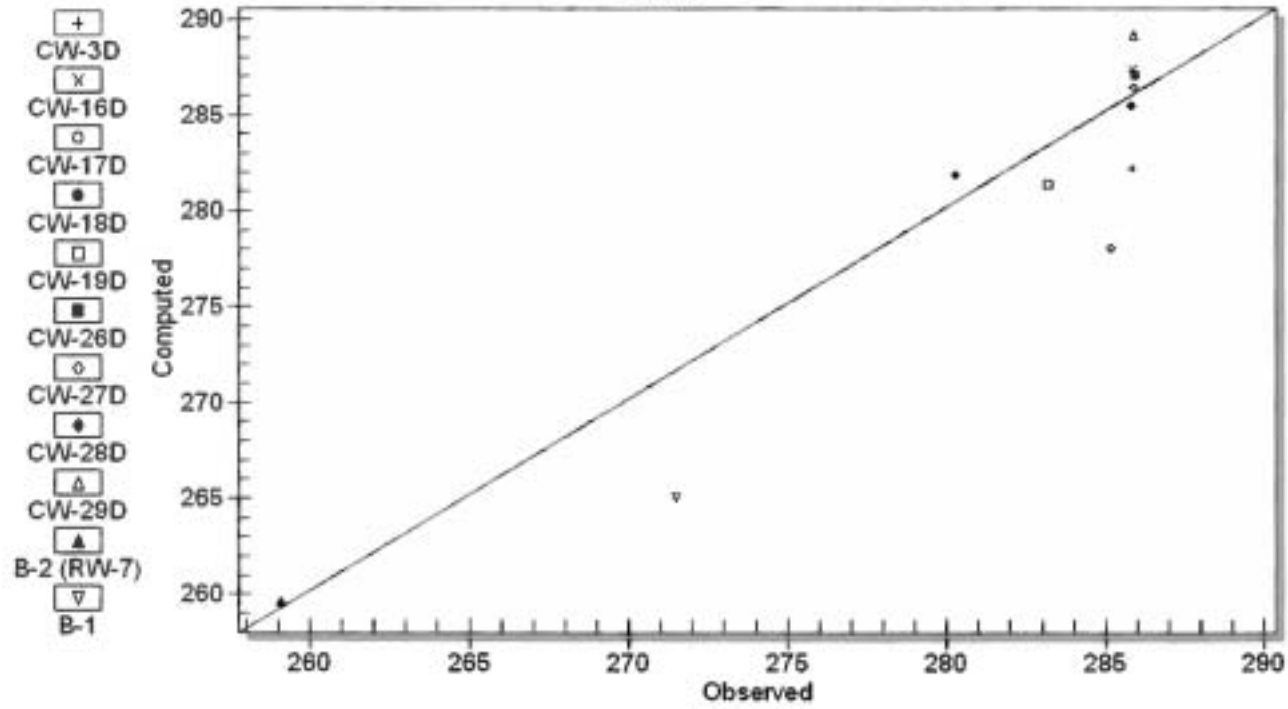
1. CONTOUR BASED ON CALIBRATION TO END OF RW-7 PUMPING TEST (ASSUMED STEADY STATE CONDITION REACHED IN PUMPING TEST)

EXPLANATION:

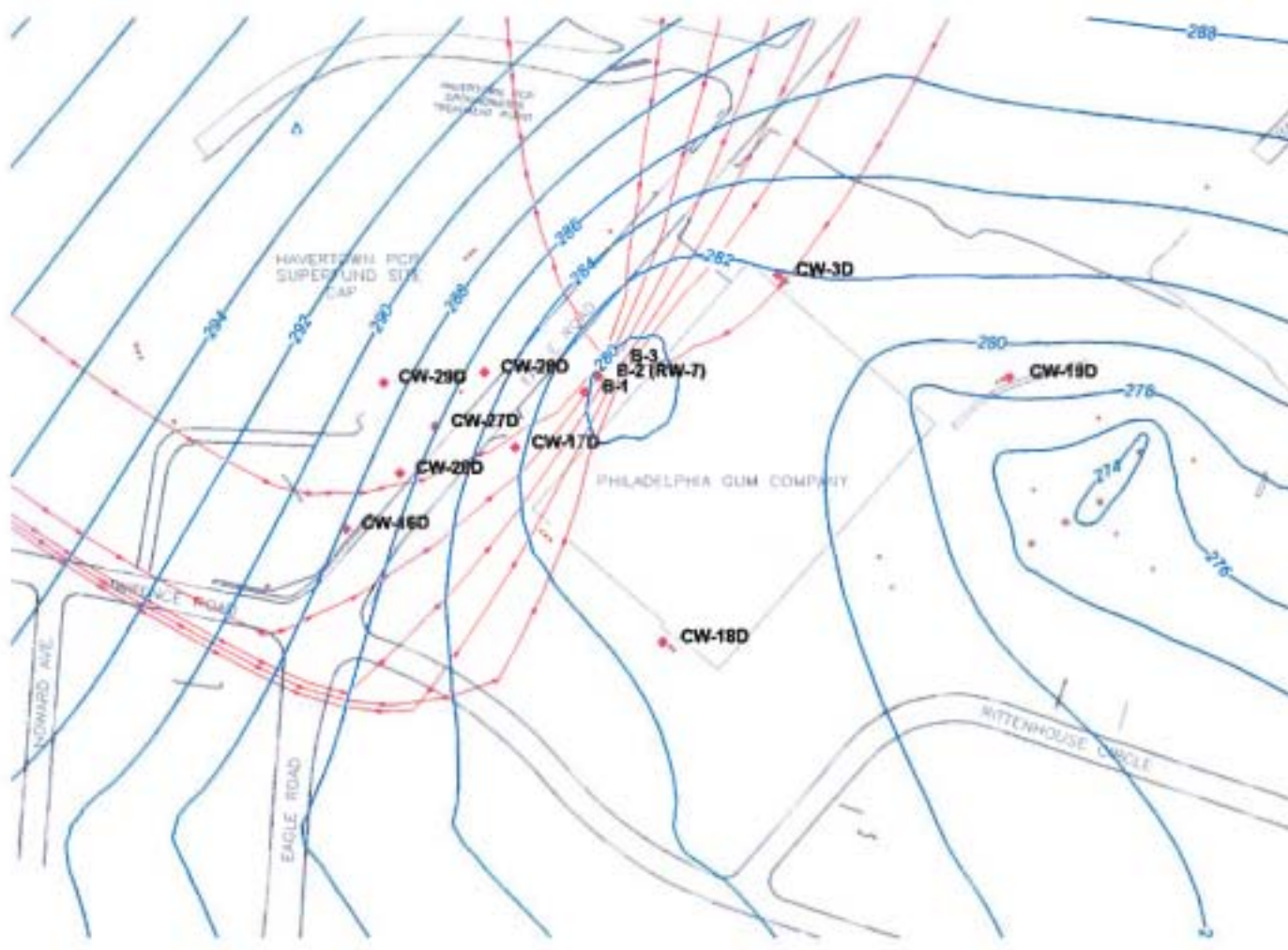


UNIVERSITY OF MARYLAND AT BALTIMORE		VAL F. BRITTON, P.G.	
PROJECT NO.	DATE	SCALE	DATE
REVISED	NO.	DATE	BY
DATE	NO.	DATE	BY
DATE	NO.	DATE	BY
DATE	NO.	DATE	BY
RW-7 PUMPING CONDITIONS 30 GPM - ASSUME STEADY STATE CONDITIONS RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA			
3			

Computed vs. Observed Values
Head



		AUTHORIZED MAPLE PA 17051 (610) 321-1100	
		VAL F. BRITTON, P.G.	(610) 321-1100
CALIBRATION OBSERVED VS COMPUTED HEAD RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA	FIELD NO.	WELL NO.	DATE
	OBSERVED VS	COMPUTED VS	DATE
	OBSERVED VS	COMPUTED VS	DATE
	OBSERVED VS	COMPUTED VS	DATE
4		4	



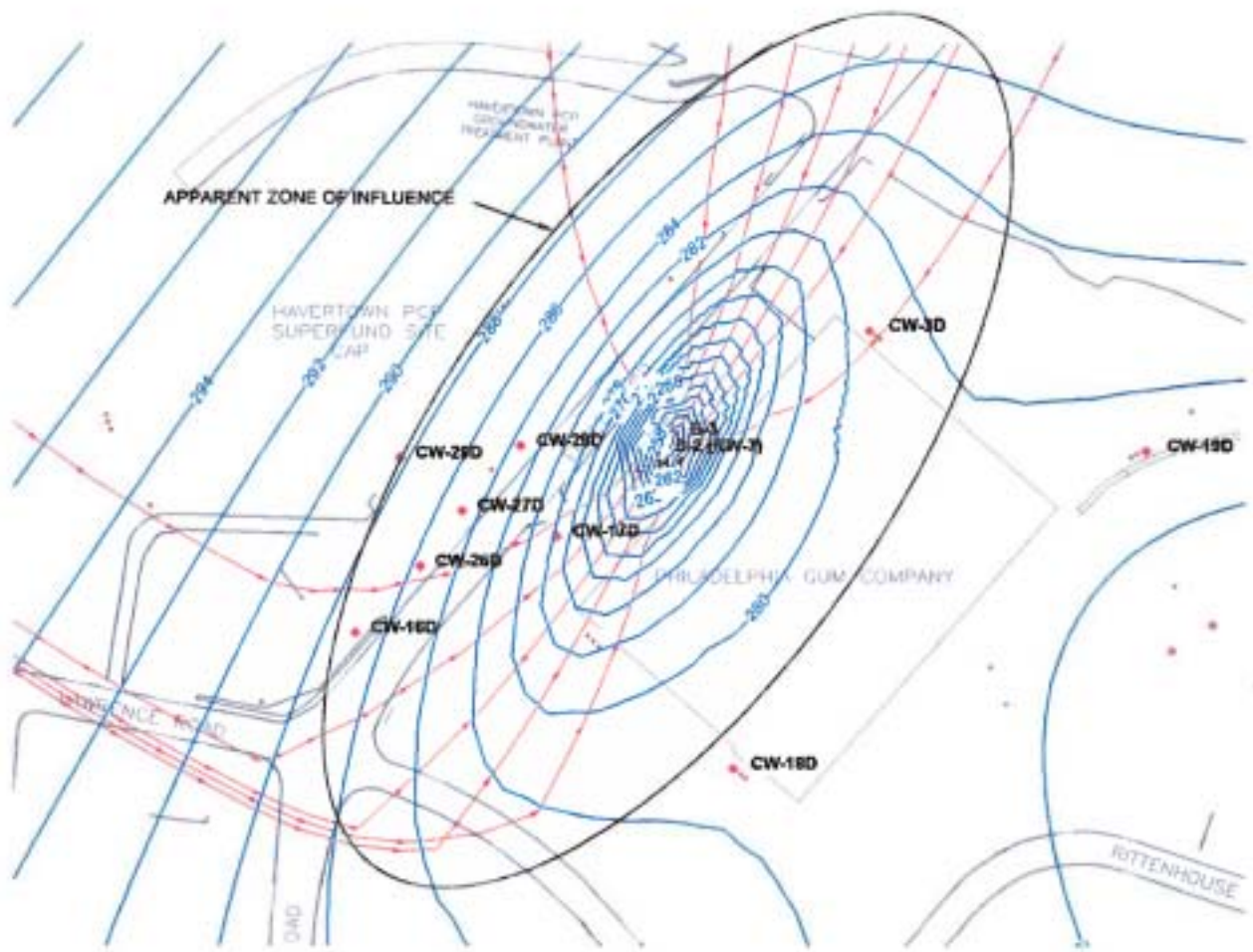
Extraction	
Trench Sump	0 gpm
RW-6	0 gpm
RW-7	30 gpm

NOTES:
 PATH LINES ORIGINATE AT WELL AND MOVE OUTWARD TO AREAS THAT ARE IMPACTED BY WELL EXTRACTION

- EXPLANATION:**
- RW-6 WELL LOCATION
 - FLOW PATH LINE (GENERAL AREA OF CAPTURE OR ZONE OF INFLUENCE)
 - GROUNDWATER ELEVATION CONTOUR (FT/MSL)



	VAL F. BRITTON, P.G. <small>PHILADELPHIA, PA. 19103</small>	<small>PROJECT NO.</small> <small>CLIENT</small>	<small>DATE</small> <small>BY</small>	<small>SCALE</small> <small>DATE</small>
PARTICLE TRACKING - ZONE OF INFLUENCE RW-7 PUMPING - 30 GPM - SAPROLITE RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA				
5				



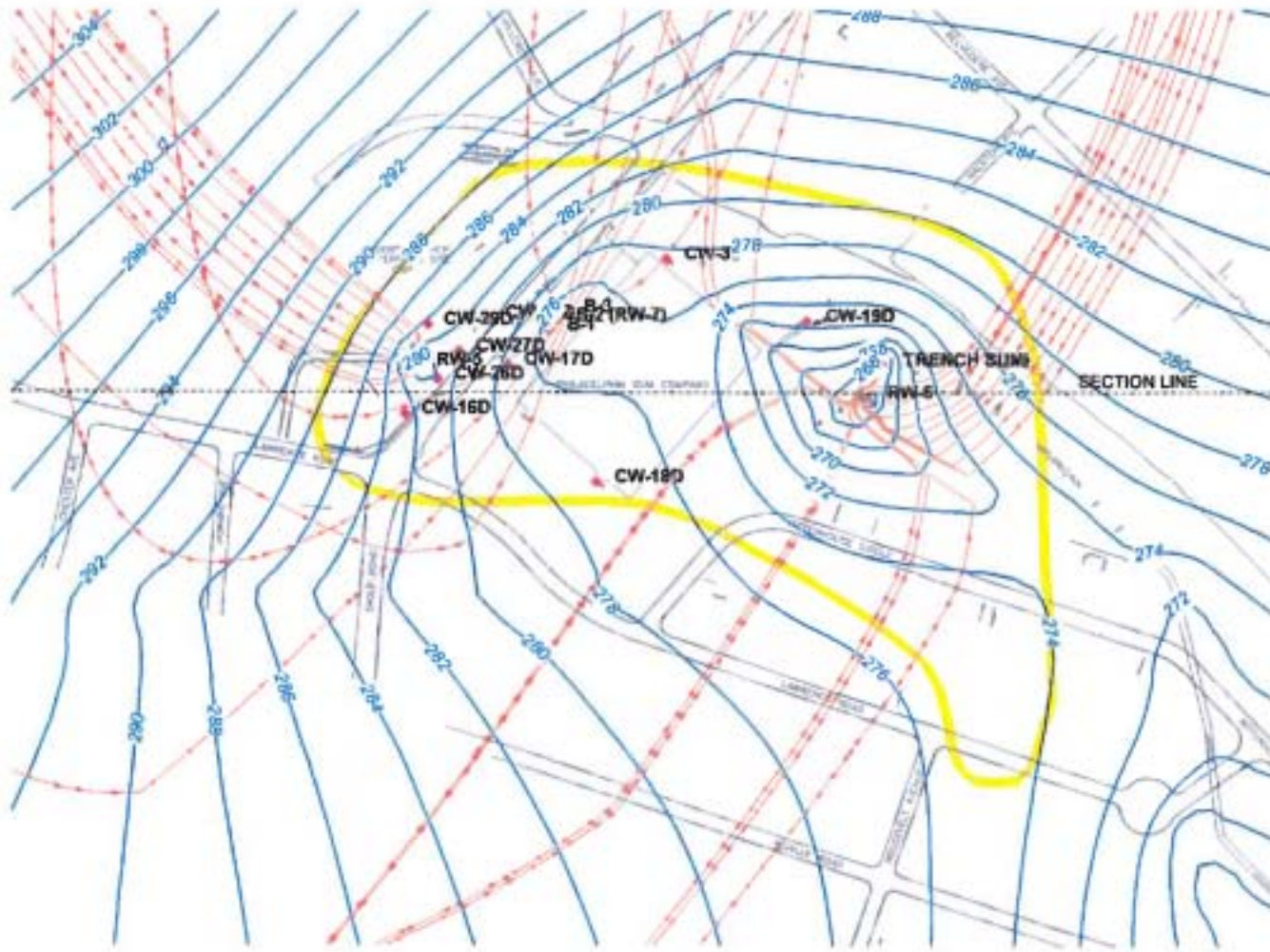
Extraction	
Trench Sump	0 gpm
RW-5	0 gpm
RW-6	0 gpm
RW-7	30 gpm

NOTES:
 PATH LINES ORIGINATE AT WELL AND MOVE OUTWARD TO AREAS THAT ARE IMPACTED BY WELL EXTRACTION

- EXPLANATION:**
- RW-6 WELL LOCATION
 - FLOW PATH LINE (GENERAL AREA OF CAPTURE OR ZONE OF INFLUENCE)
 - GROUNDWATER ELEVATION CONTOUR (FT/MSL)





	VAL F. BRITTON, P.G.	PROJECT NO. VS	SHEET NO. VS	DATE 11/11/10	SCALE AS SHOWN
PARTICLE TRACKING - ZONE OF INFLUENCE RW-7 PUMPING - 30 GPM - FRACTURED BEDROCK RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA					
6					



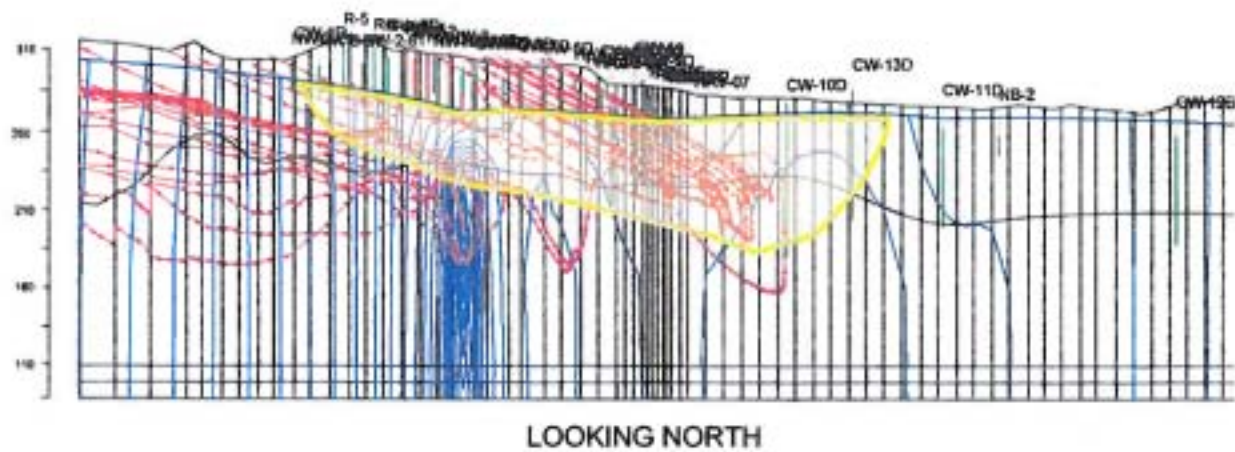
Extraction	
Trench Sump	10 gpm
RW-5	5.0 gpm
RW-6	5.0 gpm
RW-7	30 gpm

NOTES:
 PATH LINES ORIGINATE AT WELL AND MOVE OUTWARD TO AREAS THAT ARE IMPACTED BY WELL EXTRACTION

- EXPLANATION:**
-  FLOW PATH LINE (GENERAL AREA OF CAPTURE OR ZONE OF INFLUENCE)
 -  GROUNDWATER ELEVATION CONTOUR (FT/MSL)
 -  APPROXIMATE EXTENT OF DEEP PCB GROUNDWATER CONTAMINATION







		VAL F. BRITTON, P.G.	
PROJECT:	DATE:	DRAWN BY:	CHECKED BY:
HAVERTOWN	01/15/10	VFB	VFB
PARTICLE TRACKING - ZONE OF INFLUENCE ENTIRE EXTRACTION SYSTEM ACTIVE RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA			
			7



Extraction	
Trench Sump	10 gpm
RW-5	5.0 gpm
RW-6	5.0 gpm
RW-7	30 gpm

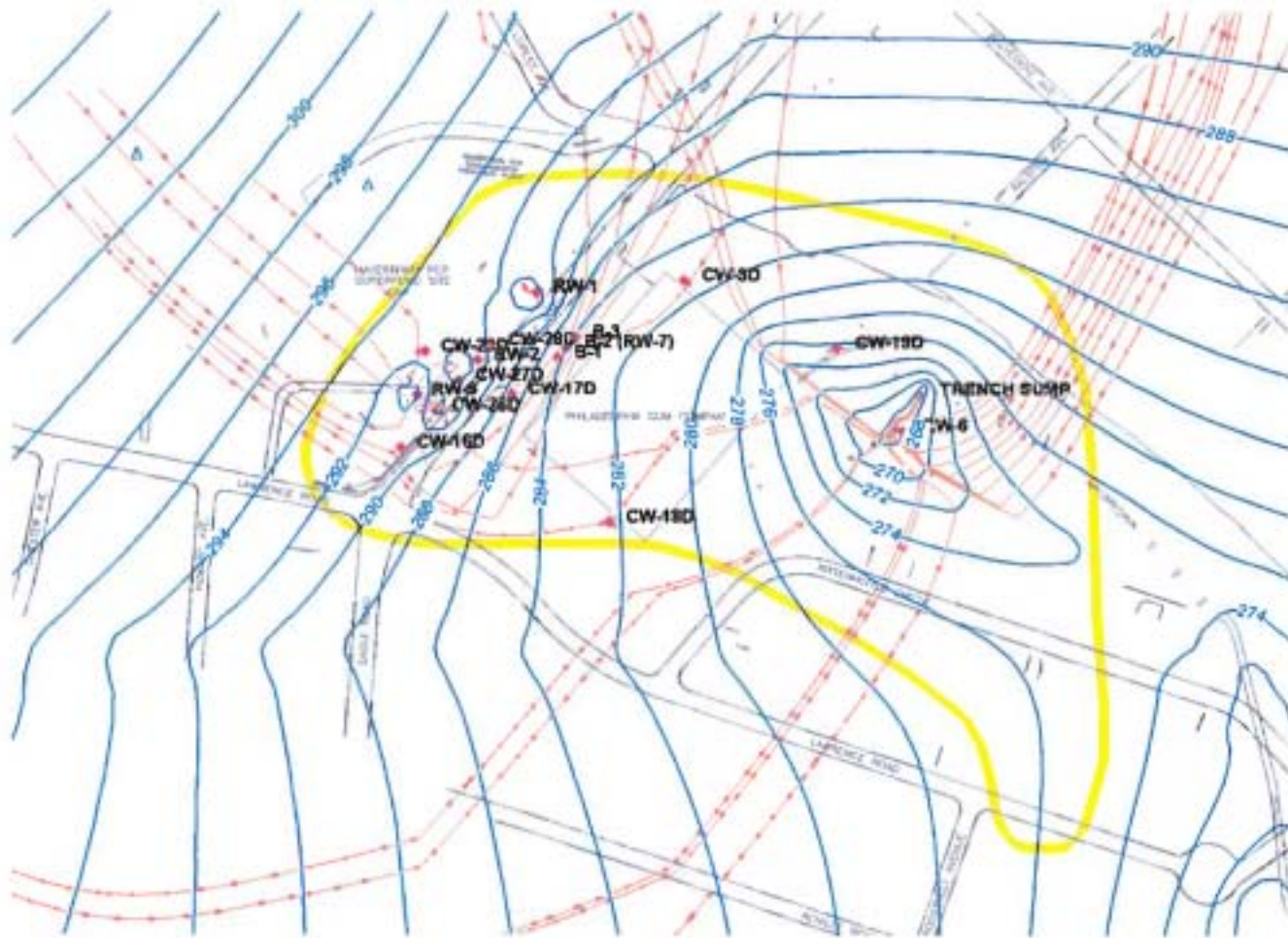
- NOTES:**
1. PATH LINES ORIGINATE AT WELL AND MOVE OUTWARD TO AREAS THAT ARE IMPACTED BY WELL EXTRACTION. PATHLINES ARE VISIBLE THROUGH ENTIRE MODEL DOMAIN IN CROSS SECTION VIEW.
 2. SEE FIGURE 7 FOR CROSS SECTION LINE

EXPLANATION:

-  RW-6 WELL LOCATION
-  FLOW PATH LINE (GENERAL AREA OF CAPTURE OR ZONE OF INFLUENCE)
-  GROUNDWATER ELEVATION CONTOUR (FT/MSL)
-  APPROXIMATE EXTENT OF PCP GROUNDWATER CONTAMINATION



	VAL F. BRITTON, P.G.								
<table border="1" style="font-size: 8px;"> <tr><td>PROJECT:</td><td>MS</td></tr> <tr><td>DATE:</td><td>11/20/08</td></tr> <tr><td>BY:</td><td>VB</td></tr> <tr><td>CHECKED:</td><td>VB</td></tr> </table>	PROJECT:	MS	DATE:	11/20/08	BY:	VB	CHECKED:	VB	PARTICLE TRACKING - ZONE OF INFLUENCE SECTION - ENTIRE EXTRACTION SYSTEM ACTIVE RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA
PROJECT:	MS								
DATE:	11/20/08								
BY:	VB								
CHECKED:	VB								
									



Extraction	
Trench Sump	10 gpm
RW-5	5.0 gpm
RW-6	5.0 gpm
RW-7	30 gpm
Injection	
RW-1	5.0 gpm
RW-2	5.0 gpm
CW-26D	5.0 gpm

NOTES:
 PATH LINES ORIGINATE AT WELL AND MOVE OUTWARD TO AREAS THAT ARE IMPACTED BY WELL EXTRACTION

- EXPLANATION:**
- RW-6 WELL LOCATION
 - FLOW PATH LINE (GENERAL AREA OF CAPTURE OR ZONE OF INFLUENCE)
 - GROUNDWATER ELEVATION CONTOUR (FT/MSL)
 - APPROXIMATE EXTENT OF DEEP PCP GROUNDWATER CONTAMINATION



		VAL F. BRITTON, P.G. <small>11100-102</small>	
<small>PROJECT NO.</small>	<small>DATE</small>	<small>SCALE</small>	<small>REVISED</small>
<small>REVISIONS</small>	<small>DATE</small>	<small>BY</small>	<small>APP'D</small>
<small>NO.</small>	<small>DATE</small>	<small>BY</small>	<small>APP'D</small>
<small>NO.</small>	<small>DATE</small>	<small>BY</small>	<small>APP'D</small>
<small>NO.</small>	<small>DATE</small>	<small>BY</small>	<small>APP'D</small>
PARTICLE TRACKING - ZONE OF INFLUENCE ENTIRE EXTRACTION/INJECTION SYSTEM ACTIVE			
RW-7 ZONE OF INFLUENCE EVALUATION HAVERTOWN, PENNSYLVANIA			
			9

GW MODELING SUMMARY

Havertown OU3A

The modeling results for the recent CW-31D/RW-7 pumping test are significantly different from those of previous pumping test conducted at the site. This is most likely a result of evaluating the deeper fractured bedrock aquifer (versus shallow bedrock/saprolite wells). The GW levels from the pumping test appear data from previous modeling/pumping test; especially based upon previous understanding of the GW system at the site. Additionally, the model calibration results are not very strong. This may be a result of the heterogeneity associated with flow along the fracture orientation but is not certain (without further evaluation). Due to the extensive precipitation prior to the pumping test (1.5-inches of rain 2 days prior to the test) it is difficult to filter out the delayed recharge affect at the deeper wells from the overlying saprolite.

Prior GW model runs have assumed unconfined conditions for the wells evaluated during previous pumping test. However, the behavior of water levels at CW-17D, CW-18D, CW-19D during the RW-7 pumping test are more indicative of confined conditions (e.g., rapid water level drop at the start of pumping and rapid recovery at the termination of pumping). This suggests that the upper saprolite zone may be acting as a "sponge" for precipitation and resulting in delayed recharge to the deeper bedrock aquifer.

It is also is unclear about what the recharge relationship is with Naylors Run (how the creek bed is tied into the shallow formation). The creek could be acting as either a "gaining stream" (draining the site GW) or "losing" stream (recharging to the site creating a GW mound). Without staff gauge data from the creek bed it is difficult to comment on this. (Our staff gauge in Naylors run "disappeared" the morning of the pumping test).

The modeling particle tracking and capture zone results for the pumping test do clearly indicate that the new recovery well should effectively capture the contaminants from the deeper GW zone of the site. However; that the particle tracking results for CW-18 and CW-19 suggest that it may not be recovering from these zones (calibration makes it questionable but not certain). This does not necessarily mean that there is no influence at these wells (this is clearly demonstrated from the recovery trench system).

The groundwater model is being further evaluated to look at various pumping optimization schemes (various cycling and rate combinations) at the site. This data will be made available once they have been received.