Hydrogeology and Chemistry Along the Southeast Lease Boundary, IBM Hangar (B953) Dutchess County Airport

Prepared for:

IBM Corporation

Poughkeepsie, New York

February, 1989

Prepared by:

Groundwater Sciences Corporation
Milton Chazen Associates
Lawler, Matusky and Skelly Engineers

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1 INTRODUCTION

The purpose of this report is to present the results of an evaluation performed by Groundwater Sciences Corporation (GSC), Milton Chazen Associates (MCA) and Lawler, Matusky and Skelly Engineers (LMS), relative to increasing concentrations of 1,1-dichloroethane (DCA) and other volatile organic compounds (VOC's) detected in monitoring wells located in the southern portion of the hangar facility leased by IBM at the Dutchess County Airport. This report describes the geology, hydrogeology, and groundwater chemistry of this area based on previous investigations and data from 6 new soil borings completed in August, 1988.

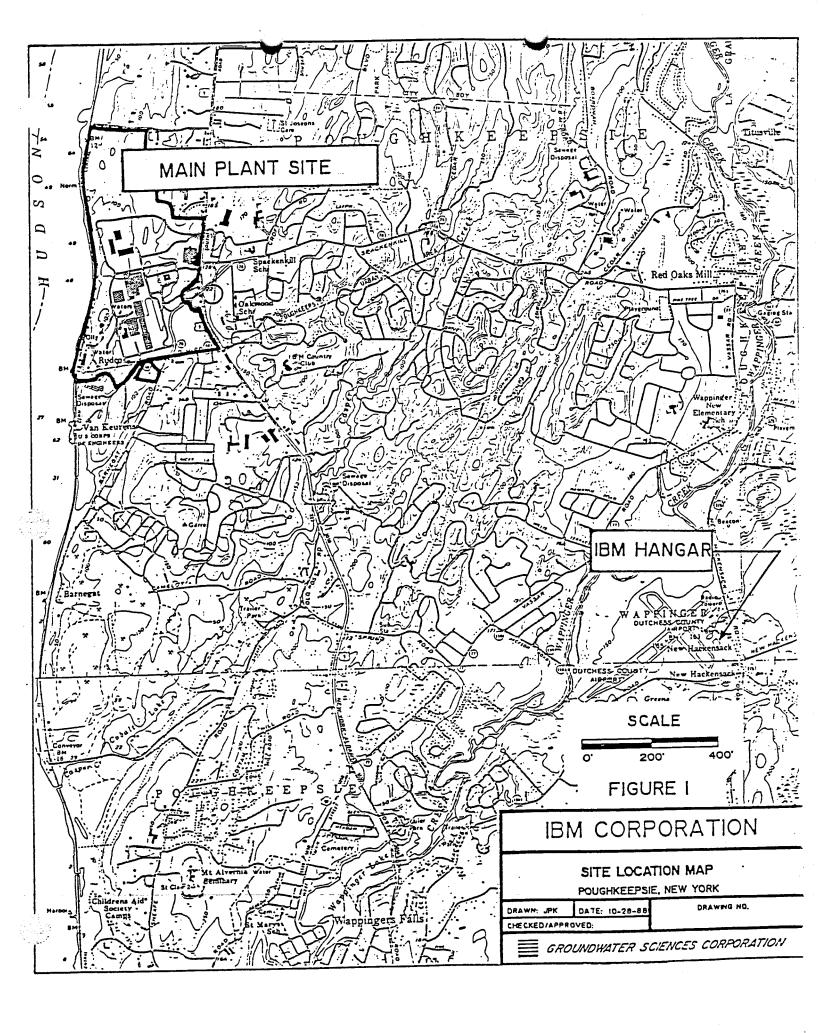
1.1 Background Information

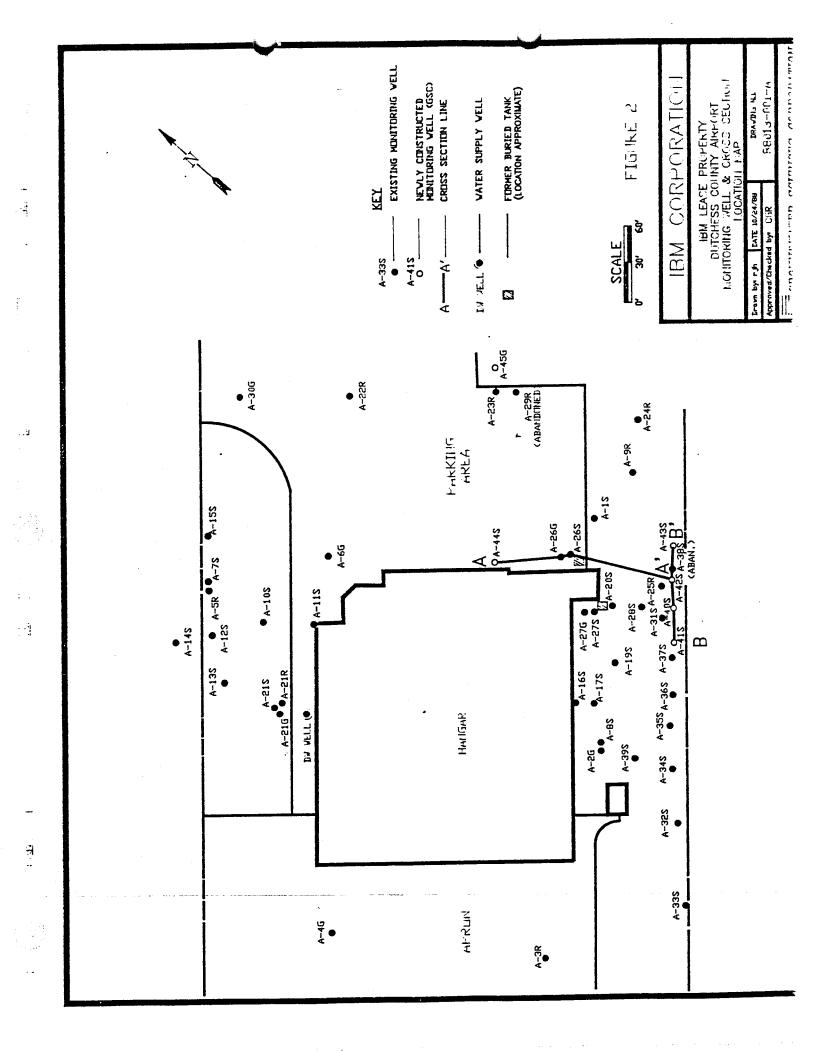
The IBM hangar facility at the Dutchess County Airport is located approximately 3.5 miles southeast of the IBM main plant site in the Town of Wappinger, New York (Figure 1). There have been several periods of investigation at this facility, which are summarized in the following paragraphs.

As part of IBM's corporate-wide groundwater investigation program, nine borings were drilled at this site in 1981 and 1982. The locations of these and all other borings drilled on this site to date are shown in Figure 2. Groundwater quality data from these first monitoring wells showed sporadic low concentrations of VOC's. However, the study concluded that there was no significant threat to human health or the environment at this site because there was no temporal or spatial pattern to the occurrence of these VOC's, and therefore, no definable movement of these chemicals.

In February, 1986, IBM detected persistent low levels of VOC's in the site's water supply well (Figure 2) and an investigation was immediately started. The study included the construction of 21 additional monitoring wells on-site (A-10 through A-30). Analytical results of groundwater

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samples recovered from these wells indicated that somewhat elevated concentrations of VOC's were present in the shallow sand water-bearing zone. The source of these VOC's on the north side of the hangar was believed to be a septic leach field, through which chemicals used during routine cleaning may have been discharged to the shallow sand. A second septic system, located south of the hanger, was also investigated. Monitoring wells constructed in the vicinity of this septic tank and the associated leach field did not indicate the presence of these same elevated concentrations, although occasional low concentrations of some VOC's were detected.

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Monitoring wells were also constructed in the vicinity of two buried dilute chemical waste storage tanks, which were previously located at the southeast corner of the hangar (Figure 2) and had been removed. The results of groundwater analyses indicated the presence of elevated VOC concentrations in one of these wells (A-20S), which monitors the shallow sand unit. Based on the vertical head distribution, it was determined that VOC's in this shallow sand unit could move downward into the bedrock unit in which the site's water supply well is constructed.

Actions taken as a result of this investigation included removing and properly disposing of the contents of both septic tanks, modifying chemical use practices inside the hangar, and providing bottled water for potable use inside the facility. Additionally, 13 monitoring wells were chosen for quarterly monitoring to ensure that VOC's dissolved in groundwater do not leave the site undetected. The site's water supply well was placed on a monthly monitoring schedule to confirm that concentrations of VOC's are not increasing.

Subsequently, in 1987, an investigation was performed along the southern property line, after oil and grease were detected in groundwater sampled from monitoring wells nearby. Additional

monitoring wells installed at that time (A-31 to A-39) revealed that fuel oil was moving onto the site along the southern property line. Toluene (TOL), benzene (BEN), xylene (XYL), ethylbenzene (EBZ), DCA, TCA, and tetrachloroethylene (PCE) were also detected at low concentrations in the groundwater during this third investigation. This study concluded that the adjacent property to the south was the source of the fuel oil and perhaps the VOC's as well.

In 1987 and 1988, a trend of increasing concentrations of DCA was noted in several monitoring wells near the southeast corner of the hangar facility. (A-20S, A-26S, and A-28S; Figures 3 to 5). Based on the pattern of these increases, it did not appear that the source of these VOC's could be from any known activity on IBM's lease property.

1.2 Purpose and Organization of this Report

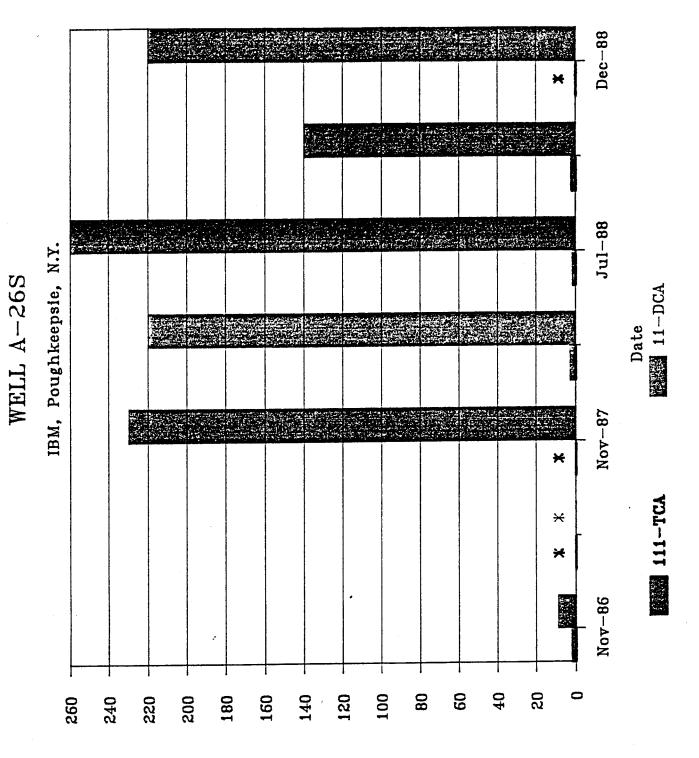
The purpose of this report is to present the results of a subsurface investigation performed in August and September, 1988 at IBM's hangar facility, to determine the possible source of these increasing VOC concentrations. The remainder of this report is organized into three sections: Site Investigation, Impact Assessment, and Conclusions.

2 SITE INVESTIGATION

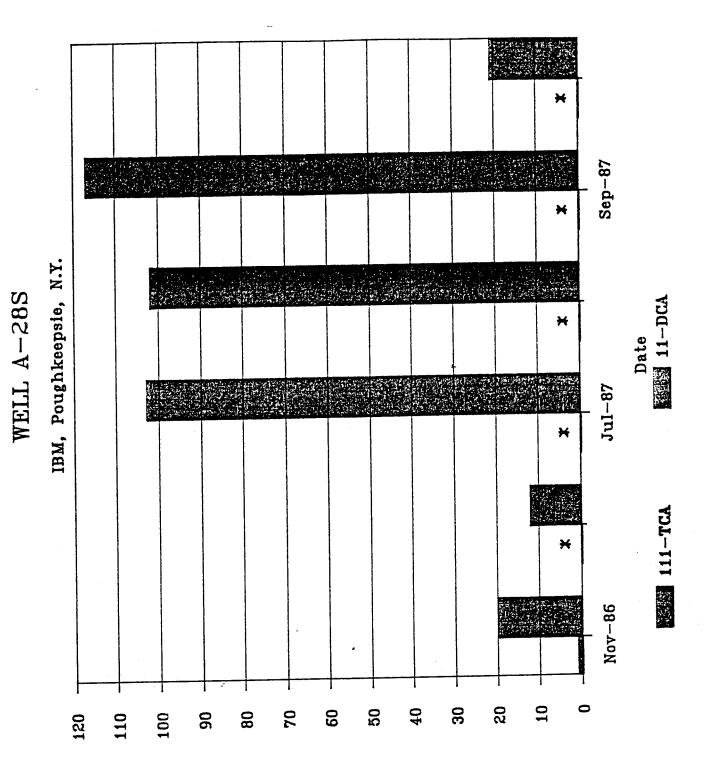
In order to evaluate the transport, fate, and potential impact of the VOC's detected in groundwater, a drilling and sampling program was initiated on August 22, 1988, using the protocols contained in Appendices A and B. Four shallow monitoring wells were drilled upgradient from A-28S (A-40 to A-43) along the southern property line (Figure 2). These additional monitoring wells were deemed necessary because wells previously installed in this area were designed to detect fuel oil and did not fully penetrate the shallowest water-bearing unit. A fifth shallow monitoring well (A-44S) was

Sep-88 医神经 经有效的 Feb-88 IBM, Poughkeepsie, N.Y. Jul-8711-DCA Feb-87 Date 为。1200年的中华的1200年的第二世纪1200年的中华的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的1200年的12 Nov-86 111-TCA Apr-86 Mar-86 120 110 100 90 80 70 60 50 40 30 20 200 190 180 170 130 160 150 140

WELL A-20S



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Concentration (ug/l)

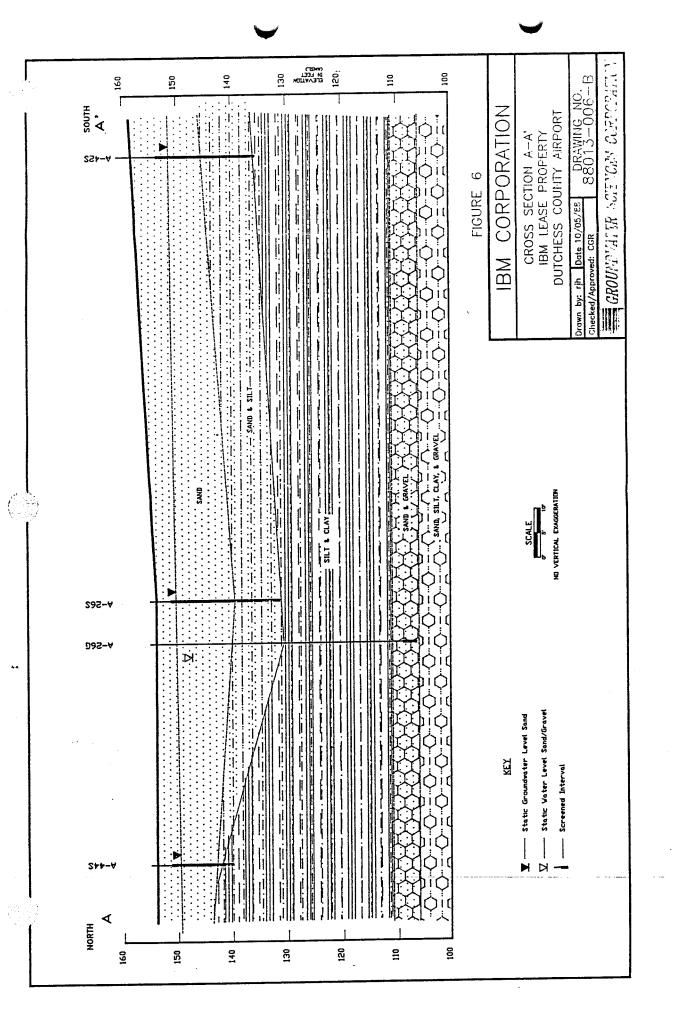
drilled adjacent to the east side of the hangar to determine groundwater quality downgradient from A-26S. A sixth monitoring well (A-45G), which penetrates a deeper sand and gravel unit, was drilled along the eastern perimeter of the site. The purpose of this well was to install a gravel monitoring well at a location where a previous attempt had failed, and was therefore unrelated to the investigation of increasing VOC concentrations. The locations of all the monitoring wells completed during this and previous investigations are shown on Figure 2. The logs of borings drilled during this investigation are located in Appendix A.

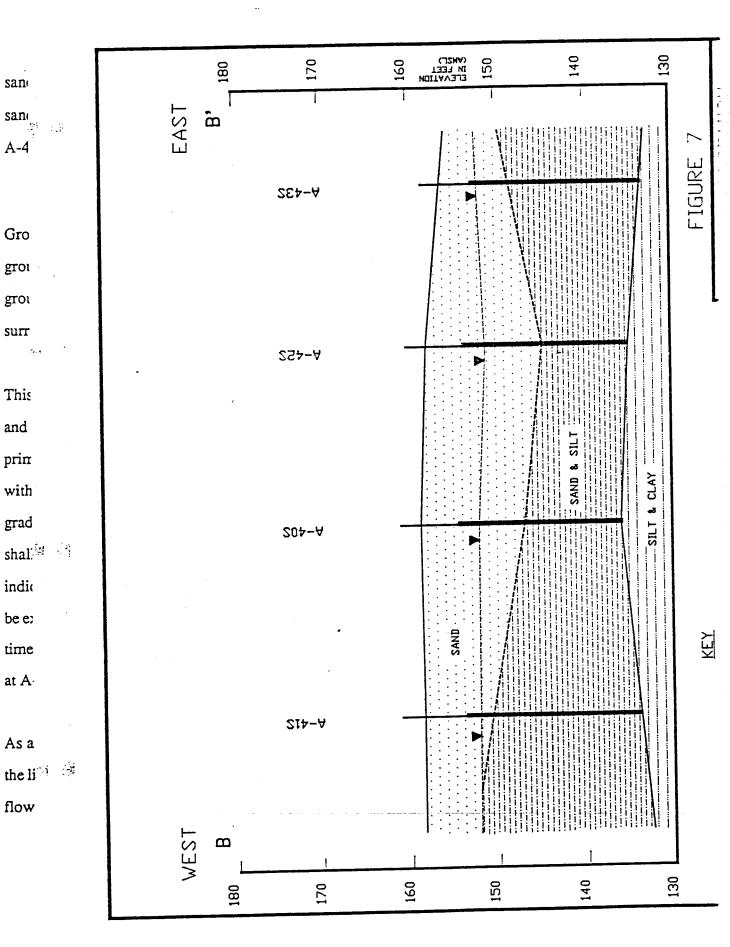
These additional monitoring wells, together with selected existing monitoring wells, were used as sampling points to further characterize the groundwater chemistry in this area. These sampling data provide the basis for the current evaluation of the southern portion of the site. Monitoring well development and sampling procedures used during this investigation are presented in Appendix B.

2.1 Geology

Previous drilling programs at this IBM facility encountered four unconsolidated units overlying argillaceous bedrock of the middle Ordovician Normanskill Formation. Two of these units are shown on cross section A-A', and four are shown on cross section B-B' (Figures 6 and 7, respectively; refer to Figure 2 for cross section locations). They include, from the surface down, a combined sand and sandy silt unit, a combined clay and clayey silt unit, a sand and gravel unit, and a glacial till unit.

Of these four unconsolidated units, the surficial unit comprised of sand and sandy silt layers is the focus of the current investigation. It consists of a 10 to 15 foot thick brown, fine to medium grained





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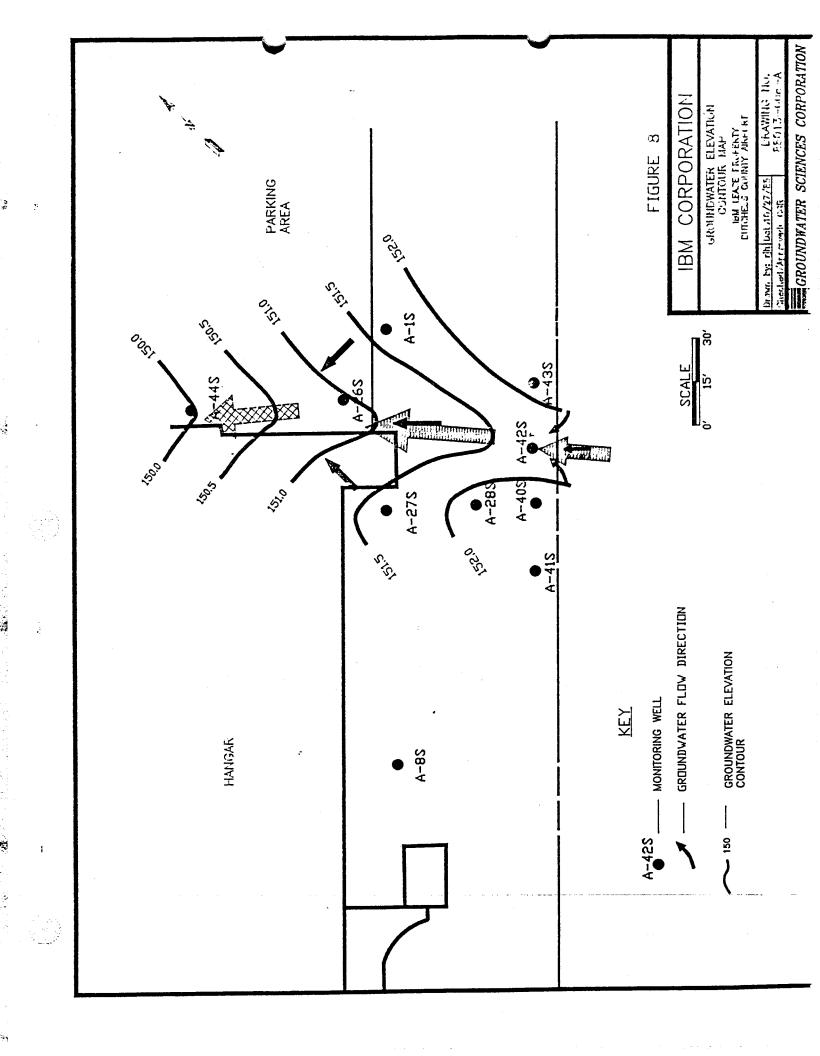
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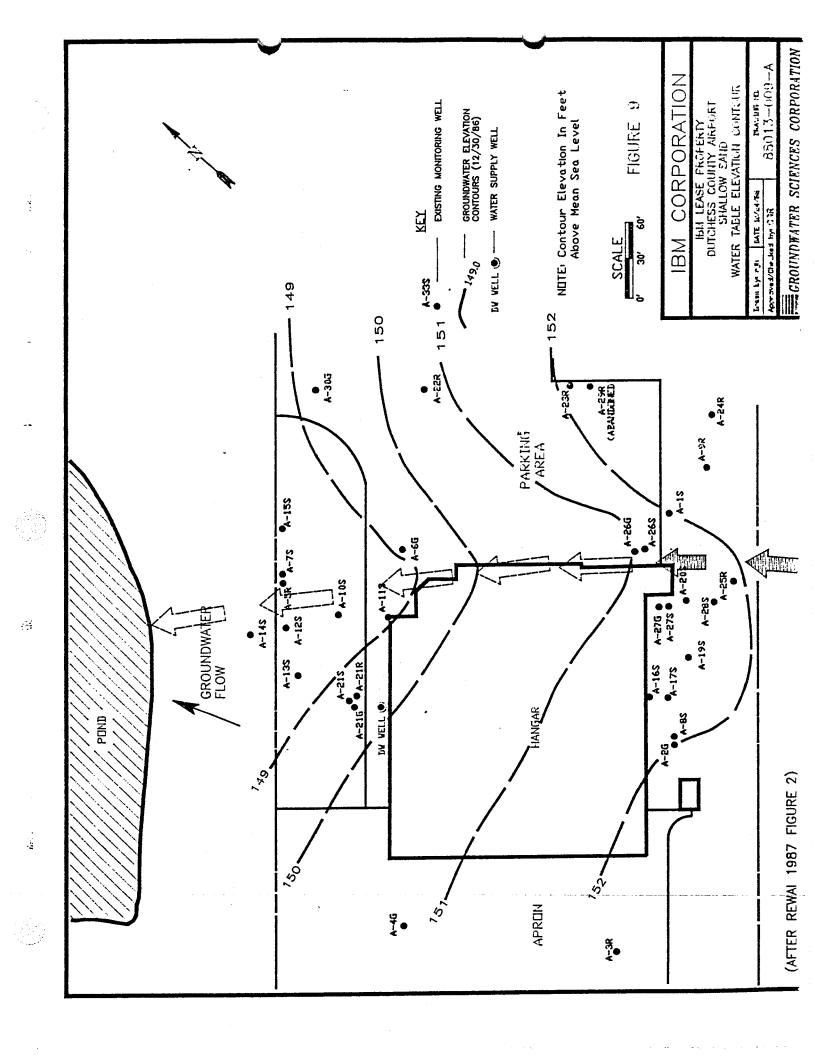
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which flows toward A-42S and then northward toward A-26S and A-44S, originates south of the IBM lease property. Previous studies have shown that shallow groundwater flow beneath the IBM site continues northward, and discharges to a pond north of the IBM lease boundary (Figure 9).

Table 1
Static Groundwater Elevations in Feet Above Mean Sea Level

Well	9-8-88	9-9-88	9-20-88	Average
A-1S	151.66	151.64	151.46	151.59
A-8S	152.07	152.02	151.75	151.95
A-26G	149.03	149.12	148.99	149.05
A-26S	151.08	151.03	150.99	151.03
A-27S	151.66	151.70	151.80	151.72
A-28S	152.32	152.26	152.03	152.20
A-40S	152.2	152.15	152.01	152.12
A-41S	152.25	152.19	151.96	152.13
A-42S	151.71	151.66	151.40	151.59
A-43S	152.28	152.21	152.07	152.19
A-44S	150.03		149.95	149.99

However, these earlier studies have also identified a vertical groundwater flow component from the shallow sand unit downward through the underlying clay and silt, and into the sand and gravel unit. This vertical gradient is apparent in the static water level data for the nested monitoring wells A-26S and A-26G, which are completed in the shallow sand unit and the deeper sand and gravel unit, respectively. The static water level in A-26G is approximately two feet lower than the water level in A-26S, creating the potential for vertical flow downward from the sand to the sand and gravel. Previous studies (REWAI, 1987) have shown that groundwater entering the sand and gravel unit beneath the IBM site also flows toward the north (Figure 10).

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Within the area of the current study, earlier work (REWAI, 1987) has also shown that this downward flow component continues from the sand and gravel unit through the underlying till and into the bedrock. Therefore, a portion of the groundwater flow crossing the southern lease boundary can move downward into the sand and gravel unit and then into the bedrock beneath the IBM site. Within the bedrock, previous studies have also shown horizontal flow directions that are not coincident with that in the shallow sand and the sand and gravel (Figure 11). Based on the combination of all vertical and horizontal flow components shown on Figures 9, 10, and 11 it is apparent that a portion of the groundwater crossing the southern lease boundary at monitoring well A-42S can eventually enter the IBM on-site water supply well and/or move off the IBM site to the east.

2.3 Groundwater Chemistry

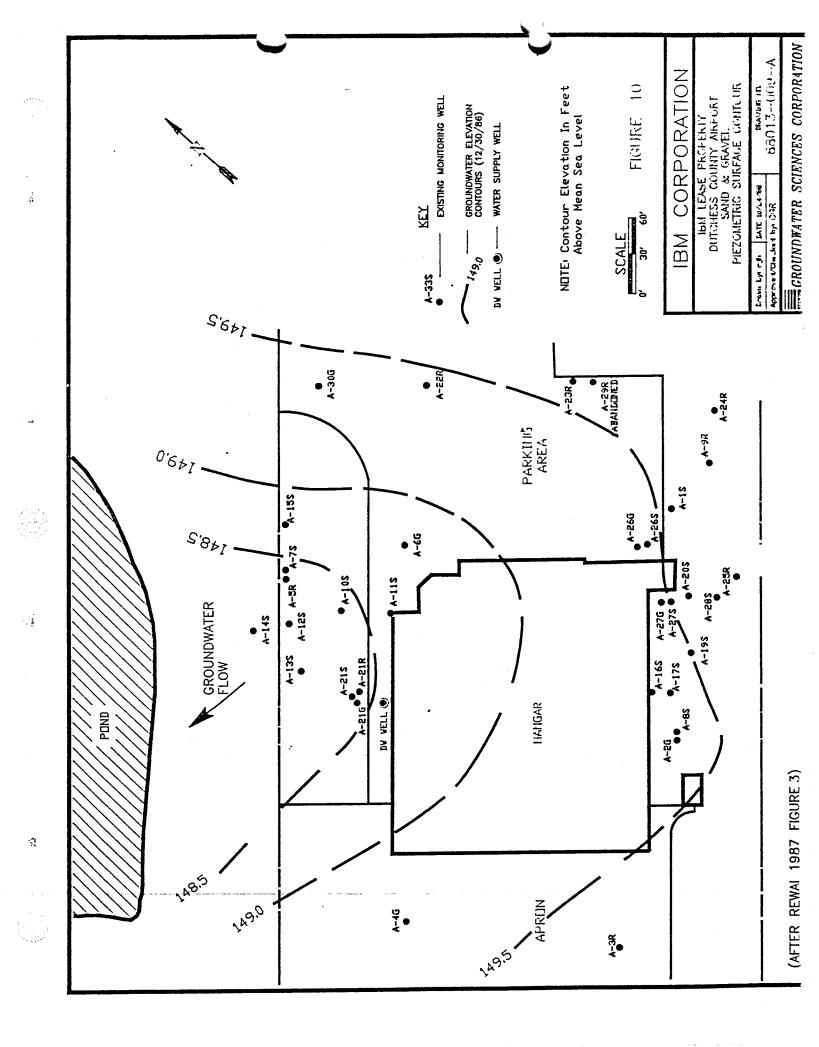
In order to characterize the distribution of VOC's in the groundwater beneath the southern portion of the IBM lease property, twenty groundwater samples were collected from nine monitoring wells, including the five newly constructed wells and four existing wells. One sample from monitoring well A-42S was analyzed for the full priority chemical list using EPA methods 624 and 625. The remaining nineteen samples were analyzed using EPA methods 601 and 602 for VOC's. The results of the full scan at well A-42S indicated that naphthalene was present in addition to the VOC's detectable using EPA methods 601 and 602. The results of these analyses are presented in full in Appendix C and are summarized in Table 2.

Table 2 Groundwater VOC Concentrations ($\mu g/l$)

Well	Date	DCA	TR12 DCE	CEA	TCA	PCE	VC	TOL	TCM	XYL
A-1S	9-8-88	3.9			3.5					
	12-1-88	11			1.8					
A-26S	2-19-88	220			2.8					
	7-29-88	260		6.0	1.5				1.6	
	9-8-88	140		7	2.2					
	12-2-88	220								
A-27S	9-8-88	70			·		•			
A-28S	9-8-88	21	·							
A-40S	8-26-88	87	15				-			
	9-8-88	51	19			1.1				
	9-21-88	71	23	1.5						
A-41S	8-26-88									
	9-8-88	1.2			1.6					
	9-21-88					-				
A-42S	8-26-88	610	74	43			23	39		52
	9-8-88	510	59						15	
	9-14-88	790	52					51		
	9-21-88	590	49						33	
A-43S	8-26-88	84		2.3						
	9-8-88	84		7.7						
	9-21-88	73								
A-44S	8-26-88	13			•					
	9-8-88	9.9								
	9-21-88	3.7								

DCA = 1,1-Dichloroethane
CEA = Chloroethane
PCE = Tetrachloroethylene
TOL = Toluene
XYL = Total Xylene
*Blanks indicate not detected at 1 ug/l

TR12 DCE = Trans-1,2-dichloroethylene
TCA = 1,1,1-Trichloroethane
VC = Vinyl chloride
TCM = Chloroform



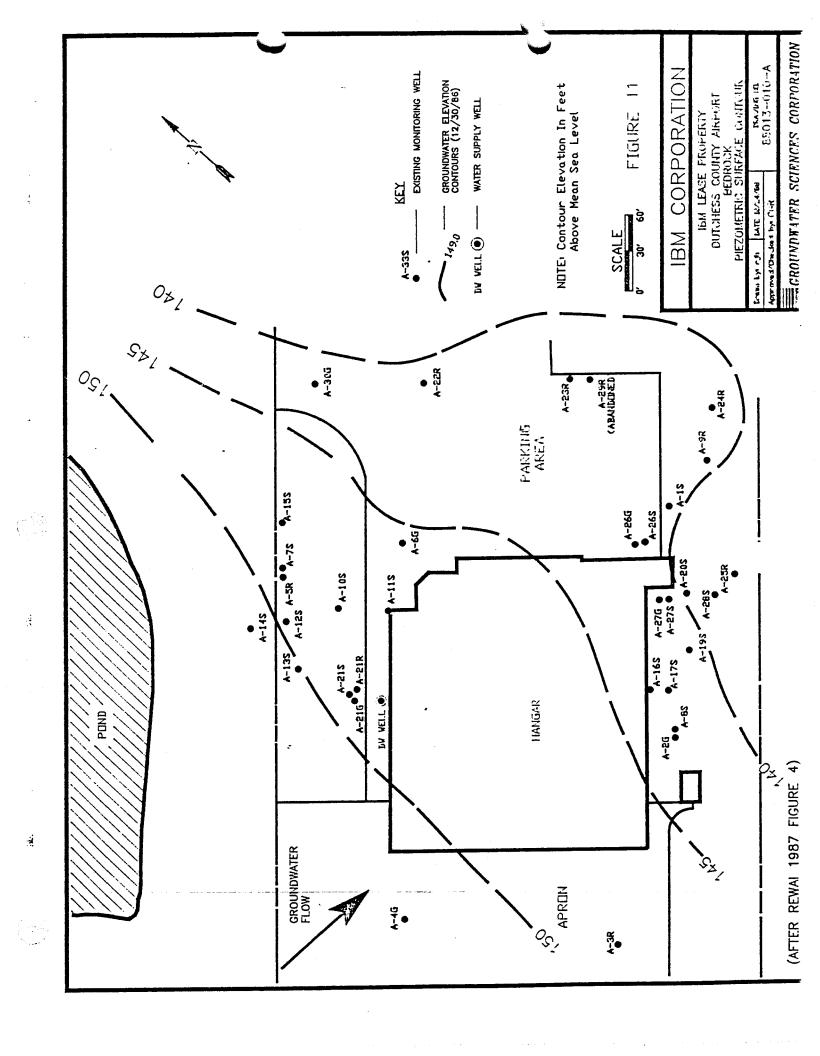
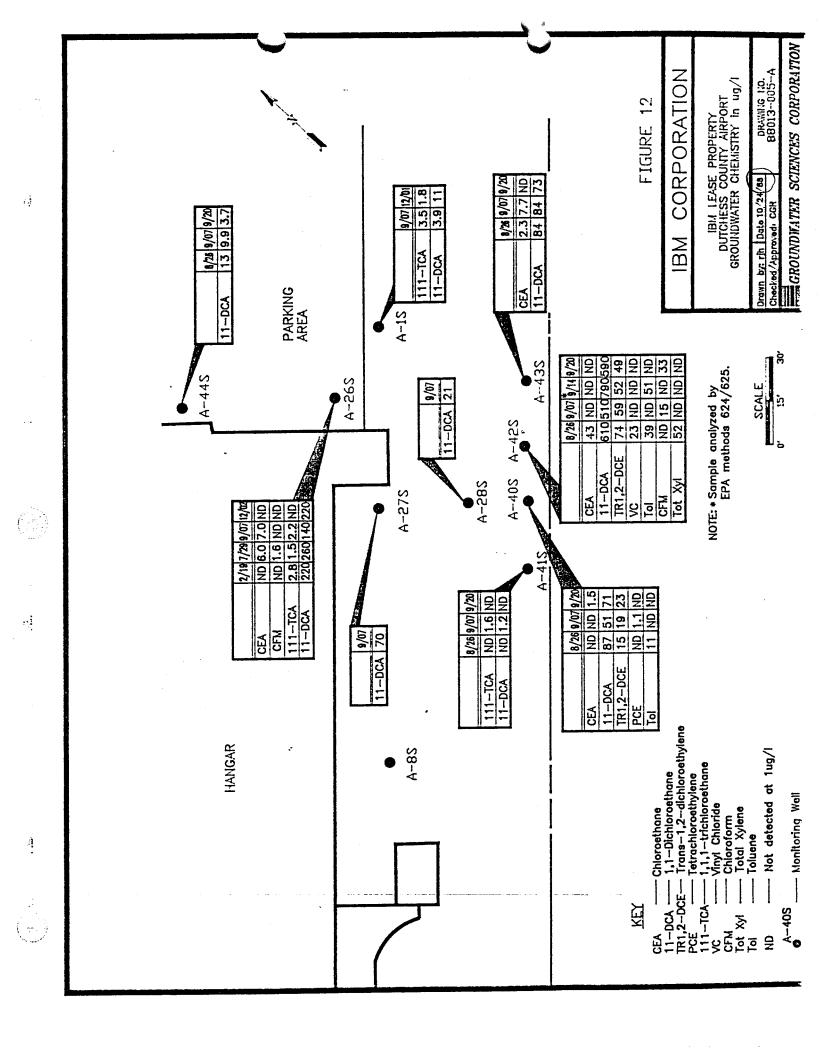


Figure 12 shows the areal distribution of chemical concentrations. The VOC with the highest concentration and most frequent detection is DCA. As shown, monitoring well A-42S exhibited the maximum reported concentration of DCA in the eight wells sampled (790 micrograms per liter (ug/l)). This is also the highest concentration of any VOC reported in any of the more than 40 monitoring wells sampled at this site to date. Monitoring well A-42S is adjacent to the southern lease boundary line for the IBM facility and concentrations of DCA in the shallow groundwater decrease in all directions, including directly down-gradient in A-26S and A-44S. Groundwater at A-42S also exhibits the highest concentrations of the following VOC's: chloroethane (CEA), chloroform (CFM), toluene (TOL), trans-1,2-dichloroethylene (TR12 DCE), and vinyl chloride (VC). Based on this distribution of VOC's and the previous discussion of the direction of groundwater flow (Figure 8), with which it is consistent, it is concluded that these chemicals are moving onto the IBM lease property from the adjacent property to the south.



3 IMPACT ASSESSMENT

Table 3 shows the maximum concentrations of VOC's detected in this investigation, together with their New York State groundwater standards and guidance values. As noted, one groundwater standard and seven guidance values are exceeded in the results from these new wells. The VOC which exceeds the New York State guidance value most frequently is DCA in monitoring wells A-26S, A-27S, A-40S, A-42S, and A-43S. DCA exceeded the guidance value in all samples from the last three of these monitoring wells. Table 2 indicates that the VC standard is exceeded in only one out of four samples at monitoring well A-42S. This is the only sample in this study in which VC was detected.

The area over which these standards and guidance values are exceeded is relatively small. However, unless the source of these VOC's is either removed or controlled, the vertical and horizontal spread of these chemicals may result in increased concentrations over a greater area and to a greater depth than is presently the case. Within the shallow sand unit itself, concentrations may begin to increase farther downgradient in monitoring wells on the north side of the hangar, which might eventually result in higher concentrations crossing the northern lease boundary and discharging into the pond.

Also, as noted above, IBM's groundwater supply well has been impacted by low concentrations of VOC's in groundwater migrating downward into the bedrock, most probably from the shallow sand unit in the area of the current investigation. VOC's from this same area could also impact perimeter monitoring wells in the sand and gravel and bedrock, although data collected to date from these wells shows no evidence of these VOC's moving off the site to the east toward private water supply

Table 3

Maximum Concentrations of Organic Detected Chemicals in Groundwater Compared with New York State Standard/Guidance Values for Groundwater

Parameter	Maximum Concentration (µg/l)	New York Standard/ Guidance Value (µg/l)		
Vinyl Chloride	23	5 (2*)		
Chloroform	33	100		
1,1-dichloroethane	790	50**		
Trans-1,2-dichloroethylene	74	50**		
Chloroethane	43	50*		
Tetrachloroethylene	1.1	0.7**		
1,1,1-trichloroethane	3.9	50**		
Toluene	51	50**		
Total Xylene	52	50**		
Naphthalene	620	10**		
Total Organics	1513***	100**		

^{*} Federal MCL

wells. Nevertheless, the increased concentrations observed in the shallow sand monitoring wells over the past year may eventually be reflected as concentration increases in IBM's supply well and/or these perimeter monitoring wells.

To understand or predict the impact that these VOC's may be having on groundwater quality in the area upgradient from IBM's lease property or other areas downgradient from the actual off-site source of these chemicals would require off-site investigations not within the scope of the current study. It should be noted, however, that water supply wells other than IBM's may be impacted now

^{**} Guidance Value

^{***} A-42S, September 14, 1988

or in the future by this off-site source of VOC's. Assurances that this is not the case can only be provided by appropriate groundwater investigations to locate, identify and remove or control the source of these chemicals.

4 CONCLUSIONS

Based on the results of the investigation described above, the following conclusions have been drawn:

- 1. VOC's in groundwater are migrating onto the IBM lease property in the shallow sand unit from an upgradient source to the south of the IBM lease boundary.
- 2. Low concentrations of VOC's identified in IBM's groundwater supply well may be due, at least in part, to this migration of groundwater containing chemicals onto the site and the subsequent vertical migration of this groundwater downward through intervening unconsolidated units into the bedrock beneath the site.
- 3. Existing flow directions in the bedrock could result in the subsequent off-site migration of this groundwater containing dissolved chemicals to the east and southeast in the direction of private water supply wells. However, IBM's perimeter monitoring well data indicates this is not yet occurring.
- 4. Increasing concentrations of these VOC's in shallow sand monitoring wells over the last year could result in similar increases in the concentrations present in the IBM supply well and/or the deeper perimeter monitoring wells.

APPENDIX A

SOIL BORING AND MONITORING WELL CONSTRUCTION PROTOCOLS; WELL LOGS

Soil Boring and Monitoring Well
Construction Protocols

SOIL BORING AND MONITORING WELL CONSTRUCTION PROTOCOL

Soil Boring

Drilling equipment and operators were provided by Soiltesting, Inc. One geologist, provided by Groundwater Sciences Corporation (GSC), was assigned to each drilling crew.

Two hollow-stem auger drilling rigs were used by Soiltesting during most of the drilling procedures. One was a Mobil B-57 and the other, a Dietrich D-52. These units were powered by a Detroit diesel and White engine, respectively. Both used 140-pound hammers to drive the split-spoon samplers, were capable of coring with water, and used the same sized hollow-stem augers. Similarities between these rigs thus assured that a uniform drilling procedure was followed.

Continuous split-spoon sampling of the overlying soils was conducted with a 2-inch O.D., 2-foot split-spoon sampler. After being advanced 2 feet, the spoon and sample were removed and the augers advanced through the same 2-foot interval. In this way, only undisturbed soil samples were collected. Acker hollow-stem augers with a 7-3/4-inch O.D. and 3-3/8-inch I.D. were used during the drilling procedures.

Soil samples were logged in the field prior to removal from the spoon, the amount of recovery was measured and the blow counts noted. Once logged, the samples were transferred to unused 8-ounce glass jar with metal screw caps. The soil samples were then transported to GSC's Harrisburg office for storage.

Monitoring Well Construction

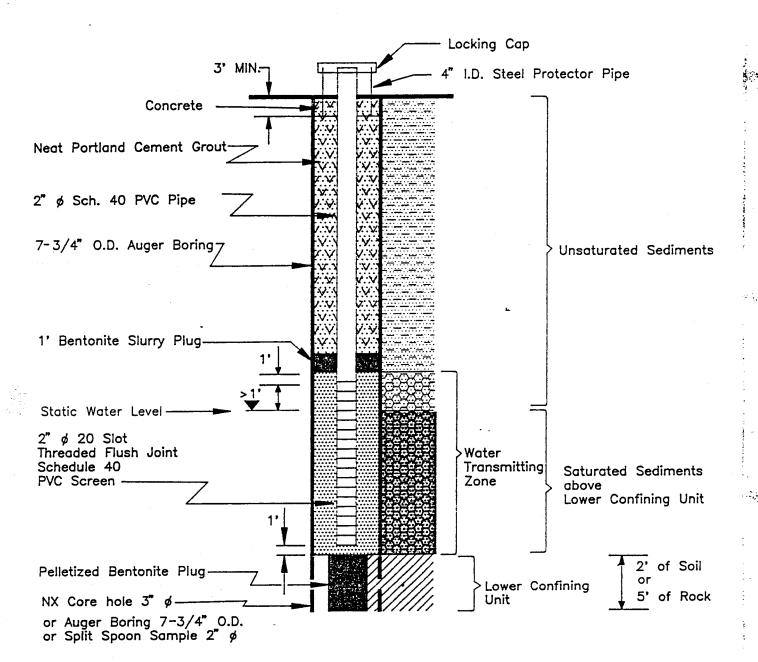
In the construction of all soil monitoring wells, a basic design was followed to maintain uniformity. This basic soil monitoring well design includes the following elements:

- 2" diameter schedule 40 threaded flush joint PVC screen and riser pipe.
- Silica sand pack material graded to specifications for the screen slot size.
- Bentonite slurry or pellets as appropriate, to seal all specified intervals of the borehole below the static water level, and any interval less than one foot above the static water level.
- Neat cement grout to seal all specified intervals of the borehole one foot or more above the static water level.
- A 4" I.D. steel protector pipe with a locking cap extending to a desired height above grade and encased in concrete to a minimum of three feet below grade; or, a properly-designed, commercially available monitoring well manhole, with interval locking cap, encased in concrete at grade, with proper provisions for seepage water drainage based on site-specific conditions.

Variations on this basic design were determined by the elevation of the static water level (SWL) with regard to the site stratigraphy.

The first variation of this basic monitoring well design is the soil standpipe, which was used to monitor unconfined water table conditions in the shallow sand unit. In this variation, the top of the screen extends above the static water level (Figure A-1). It was used in the construction of monitoring wells A-40S to A-44S.

Figure A-1
SOIL STANDPIPE



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The second variation used in this investigation was the construction of a soil piezometer (Figure A-2) at location A-45G. In this variation, the well monitors a confined water-transmitting unit, where the static water level is above both the top of the unit (in this case the sand and gravel) and the top of the screened interval.

Decontamination

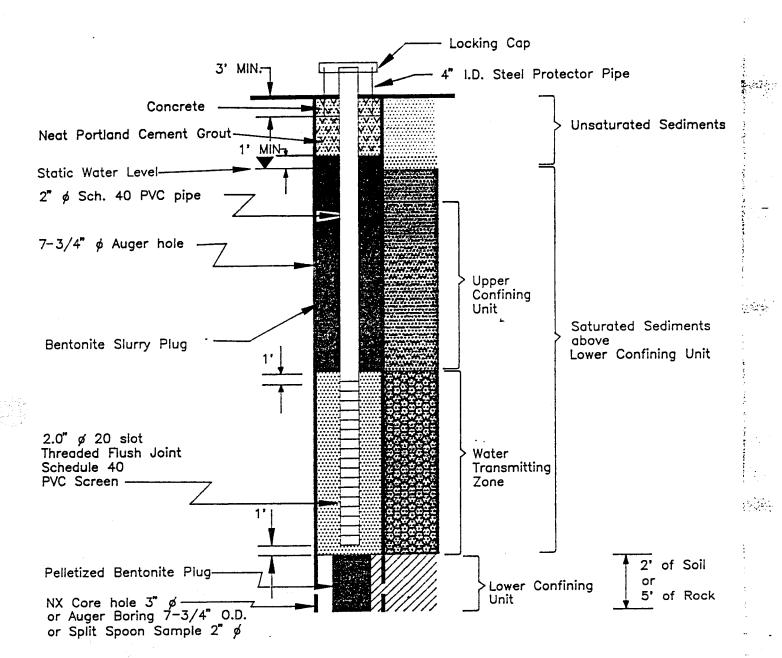
In order to reduce the potential for contamination of groundwater samples from drilling equipment and well construction materials, several precautions were taken, as follows:

- 1. The threaded flush joint PVC pipe and screen used in all soil borings was steam-cleaned immediately prior to being used.
- 2. The screen and pipe were lowered into the borehole by hand, so they did not contact the drilling equipment during the installation process. Additionally, all workers handling these materials were new, clean surgical gloves.
- 3. The drilling rigs and tools were also thoroughly steam-cleaned, both prior to mobilization to IBM's property and during drilling operations before equipment was moved from one drill site to another. In addition, the split-spoon samplers were steam-cleaned on site before being used or reused.

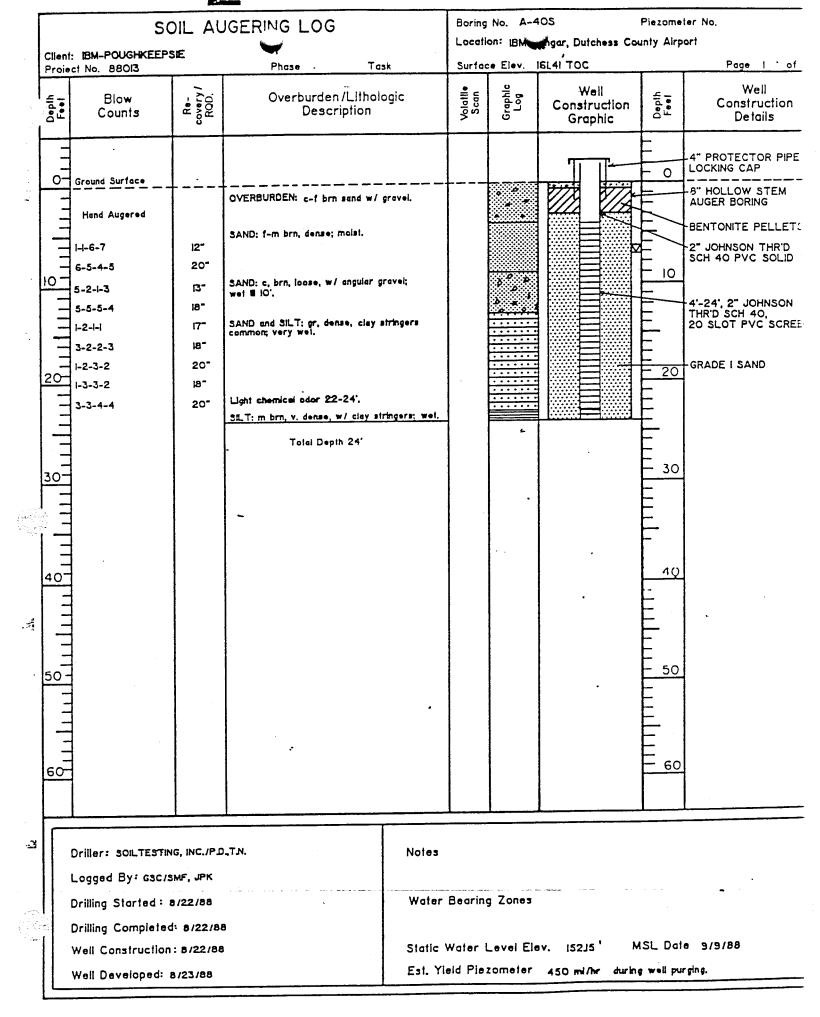
Quality Control

Each two-man crew of drill rig operators was supervised by one GSC geologist. Both the drillers and supervisors maintained separate records of the blow counts required to drive the spoon. In addition, separate field logs of the soil samples were maintained. It was the responsibility of the GSC geologist to select an appropriate boring design, and ensure that the well was constructed according to protocol. Additional responsibilities included: measurement and recording of static water levels; field logging of soil samples with respect to odor, color, and texture; and implementation of decontamination procedures.

Figure A-2
SOIL PIEZOMETER



Well Logs



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				1								
	SOIL AUGER LOG					Boring No. Piezometer No.						
Clien	Client: IBM-POUGHKEEPSIE					Location: IBM Hangar, Dutchess County Airport Surface Elev. IGLO7 TOC Page 1						
1	ct No. 88013	,	Phase Task	Surfa	ce Elev.	IGLO7 TOC	Υ	Page 1 of				
Depth	Blow Counts	Re- covery/ RQD,	Overburden/Lithologic Description	Volatile Scan	. Graphic Log	Weil Construction Graphic	Depth Feet	Well - Construction Details				
0-	Ground Surface						- 0	4" PROTECTOR PIPE				
10-	Hand Augered 4-5-6-5 7-7-5-4 3-3-3-3 4-3-5-4 3-2-3-3 1-2-3-4 2-3-3-2 3-4-5-5 3-4-5-6	18" 12" 20" 15" 16" 20" 15"	OVERBURDEN: 1 brn sand; w/ carbonate fill gravel. SAND: 1, brn, dense; mottled; w/ tr of silt and gravel; moist. SAND and SiLT: 1, brn, dense; very wet; clay stringers becoming more common with depth. SAND: 1-m, dk brn, dense; very wet; some clay stringers. SAND and SiLT: gr, dense; v. wet; w/ clay stringers. Total Depth 26					BENTONITE SLURRY BENTONITE PELLET 2" JOHNSON THR'D SCH 40 PVC SOLID 8" HOLLOW STEM AUGER BORING -GRADE I SAND -5'-25', 2" JOHNSON THR'D SCH 40, 20 SLOT PVC SCRE				
50-							- 40 - 50 - 60					

Driller : SOILTESTING, INC./P.D.,T.N.

Logged By: GSC/ SMF,JPK

Drilling Started: 8/22/88

Drilling Completed: 8/22/88

Well Construction: 8/22/88

Well Developed: 8/23/88

Notes

Water Bearing Zones

Static Water Level Elev. 15219 MSL Date 9/9/88

Est. Yield Piezometer 450 mi/hr during well purging.

SOIL AUGER 3 LOG Boring No. & Plezometer No. Location: IBM Trangar, Dutchess County Airport Client: IBM-POUGHKEEPSIE 160.53 TOC Surface Elev. Page 1 of Task Project No. 88013 Well Graphic Log Well Rob. Overburden/Lithologic Blow Depth Feet Construction Construction Description Counts Details Graphic 4" PROTECTOR PIPE LOCKING CAP 0 0-Ground Surface BENTONITE SLURRY OVERBURDEN: c-m, orange to dk brn, loose sand w/ fine gravet saturated # 6'. BENTONITE PELLETS Hand Augered 2" JOHNSON THR'D SCH 40 PVC SOLID 18-4-7-8-5 5-3-3-4 14-10 10 -SAND: f-m, gr to brn, w/ some silt; silt content 2-2-6-9 14" 8" HOLLOW STEM increases w/ depth; or-brn 8 wet 8 il'8". AUGER BORING 18-7-7-7-8 SAND and SILT: f-m, gr to brn, dense; 2-3-3-2 18" w/ II tan clay interbeds; wel. -4'-24', 2" JOHNSON THR'D SCH 40, 17-3-2-2-2 20 SLOT PVC SCREE 20 3-4-4-4 20 20-18" 1-2-4-7 GRADE I SAND 20-6-6-5-8 SET: gr-brn, dense, wel; interbedded fan clay. Total Depth 24' 30 30-40 40 50 50 60 60 Notes Driller: SOILTESTING, INC./BD.T.N. Logged By: GSC/JPK Water Bearing Zones Drilling Started: 8/23/88 Drilling Completed: 8/23/88 Static Water Level Elev. 15166 MSL Date 9/9/88 Well Construction: 8/23/88 Est. Yield Piezometer 450 ml/hr during well purging.

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Well Developed: 8/24/88

GRUUNUNATER SCIENCES CURPURATION

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		. 50	DIL AL	JGEF G LOG	i			Piezome	
İ	Client	: IBM-POUGHKEEP	SIF		ł		Hangar, Dutchess Co	unty Air	port .
		ct No. 88013	JIE	Phase Task	Surfa	ce Elev. I	58.54 TOC	,	Page 1 of
	Depth Feet	Blow Counts	Re- covery / ROD.	Overburden/Lithologic Description	Volatii• Scan	Graphle Log	Weil Construction Graphic	Depth Feet	Well Construction Details
	0-	Ground Surface				ATTACOMICS O	14000	- 0	4" PROTECTOR PIPE LOCKING CAP
	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Hand Augered 3-4-4-4 3-3-4-4 5-6-7-7 4-5-5-6 3-3-4-4 4-3-4-4 1-2-3-3 2-4-5-4 3-5-7-7 3-3-3-4	13- 20- 20- 16- 18- 20- 18- 17-	OVERBURDEN: c-m, dk brn sand w/ silt and f gravel; loose; moist; wet \$6'. SAND and SILT: f-m, brn; or-tan mottling \$10'; dense; thin clay interbeds appearing \$1'; some gray sand stringers. CLAY and SLT: gr, dense; interbedded; wet. Tatal Depth 26'				- 10 - 20 - 30 - 40 - 50	LOCKING CAP BENTONITE SLURRY BENTONITE PELLET: 2" JOHNSON THR'D SCH 40 PVC SOLID 8" HOLLOW STEM AUGER BORING 4'-23', 2" JOHNSON THR'D SCH 40, 20 SLOT PVC SCREE GRADE I SAND CAVED FORMATION AND BENTONITE
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Driller: SOILTESTING, INC./B.D.,T.N.

Logged By: GSC/JPK

Drilling Started: 8/23/88

Drilling Completed: 8/23/88

Well Construction: 8/23/88

Well Developed: 8/23/88

Notes Formation caved in bottom of bore hole during bentonite piecement and suger retrieval.

Water Bearing Zones

Static Water Level Elev. 152.21 MSL Date 9/9/88

Est. Yield Plezometer 450 milhr during well purging.

GRUUNVIATER SCIENCES CURPURATION

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	S	DIL AL	JGER LOG	Į.	No. A	angar, Dutchess Cou	Piezome	
Client	: IBM-POUGHKEEP	SIE	•	!			Jiliy Airp	
	ct No. 88013		Phase Task	Surfac	e Elev.	55.30 '63	·	Page 1 of
Depth Feet	. Blow Counts	Re- covery/ ROD.	Overburden/Lithologic Description	Volatile Scan	Graphic Log	Well Construction Graphic	Depth Feed	Well Construction Details
								9" ACCESS MANHOLE
0-	Ground Surface	L			حد		0	ALUMINUM MORRISON CAP W/ BRASS
	Hand Augered		OVERBURDEN: (Fill Material), c-m, or-brn sand w/ gravel 8 cobbles; wet 2 6'.		o. O.			ADAPTOR & LOCK BENTONITE PELLETS
-	8-7-3-4	20-	•				F	2" JOHNSON THR'D SCH 40 PVC SOLID
1 =	4-3-5-6	18-	•		0.0		E_	
10	3-4-4-3	15"			0.0		10	8" HOLLOW STEM AUGER BORING
	4-5-4-3	14"			Ç. Ç		<u> </u>	-4'-14'. 2" JOHNSON
	4-6-6-6	18°	SET: gr, dense; tr. fine sand & clay; wet.		===		F	THR'D SCH 40, 20 SLOT PVC SCREE
	4-4-7-6	17"	SLT; gr, dense; fr. clay; wet.			0 0 0	F	GRADE I SAND
	6-6-7-7	19-				0000	E.	
20-						1:.7::U::0::U:	20	CAVED FORMATION AND BENTONITE
			Tatel Depth 20'				E	MAD DEIT I OMITE
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Driller: SOLTESTING, INC./BD.T.N.

Logged By: GSC/JPK

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Drilling Started: 8/23/88

Drilling Completed: 8/24/88

Well Construction: 8/24/88

Well Developed: 8/24/88

Notes Formation caved in bottom of bore hole during bentonite placement and auger retrieval.

Water Bearing Zones

Static Water Level Elev. 149.95 MSL Date 9/20/88

Est. Yield Plezometer 450 milhr during well purging.

= 01,00,101/01 = 1. 00,=110=0 0011/0/1/0/1

Proiect	BM-POUGHKEEP No. 88013 Blow Counts Found Surface and Augered	Re- COVETY / RQD.	Phase Task Overburden /Lithologic Description OVERBURDEN: (Fill Material), c, brn sand & silt;			angar, Dutchess Co 56.58'TOC Well Construction Graphic	Depth Feet	Page 1 of Well Construction Details
O Gr 1 He 4- 3- 10 2- 3- 20 8- 1 4- 4- 7- 30 3- 4- 4- 1 7- 30 3- 4- 4- 4- 4- 4- 4- 4- 4- 4- 4	Counts	Re- covery/ RQD.	Description	Volatille Scan	Graphla Log	Construction	Depth Feet	Construction
1 He	and Augered		OVERBURDEN: (Fill Material) c brn sand & silt					
3- 40 3- 5- 7- 1 8- 50 9-	-2-4-3 -2-4-5 -4-5-6 -2-2-4 -4-5-6 -6-8-8 -7-7-6 -8-9-10 -4-4-4 -4-8-9 -8-8-9 -4-6-5 -4-4-3 -3-3-4 -3-3-4 -3-3-4 -3-3-4 -3-3-4 -3-3-4 -3-3-4 -3-3-4 -3-3-9 -4-5-8 -4-5-9	16" 16" 14" 20" 18" 17" 20" 22" 20" 17" 16" 14" 20" 19" 22" 23" 6" 20" 18" 14" 16" 8" 6"	tr. gravel; loose. SAND and GRAVEL: c-m, brn sand & f. grvl; v. loose; saturated & 3' w/ oily film. SAND and SILT: f-m, brn-or, brn; si. dense; small tan clay stringers becoming more common w/ depth. SILT: gr., dense; some f. sand; tr. clay; wet. SILT and CLAY: gray, dense; interbedded w/ v.f. sand. CLAY: gray, dense; w/ some silt; wet. CLAY: gray, dense; w/ some silt; wet. SILT: gray, dense; w/ some c-f sand & c-f grevet; moist. SANO and GRAVEL: c-f, gray sand & c-f grevet; moist.				- 0 - 10 - 20 - 30 - 30 - 50 - 50	4" PROTECTOR PIPE / LOCKING CAP SOIL FILL GROUT GRADE I SAND & BENTONITE PELLETS 8" HOLLOW STEM AUGER BORING BENTONITE SLURRY 2" JOHNSON THR'D SCH 40 PVC SOLID
60 16	5-9-43-66	9* 8*	SANO and GRAVEL: gray, v. dense c-m sand & c-f grvi, w/ sil & clay; moist. Total Depth 60'			0000	60	CAVED FORMATION AND BENTONITE

Driller: SOILTESTING, INC./B.D.T.N.

Logged By: GSC/JPK

Drilling Started: 8/24/88

Drilling Completed: 8/25/88

Well Construction: 8/25/88

Well Developed: 8/26/88

Notes Formation caved in bottom of bore hole during bentonite placement and auger retrieval.

Water Bearing Zones: 54'-57'

Static Water Level Elev. 148.33'

MSL Date 9/20/88

Est. Yield Plezometer

APPENDIX B

WELL DEVELOPMENT, SAMPLING AND QA/QC PROTOCOLS

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Well Development Protocol

High Yielding Wells

- 1. Record all physical information as listed on the header of the well development field data sheet.
- 2. Determine and record the static water level and the depth to the bottom of the well.
- 3. Determine the volume of water present in the column by taking the difference between the static water level and the depth to the bottom of the well times the volume per foot of casing based on its diameter.

1.5" = 0.092 gals/ft. 2.0" = 0.163 gals/ft. 4.0" = 0.65 gals/ft. 6.0" = 1.6 gals/ft. 8.0" = 2.6/gals ft.

- 4. Small diameter wells (<4.0") with a static water level of less than 25 feet from the top of the casing will be developed using a peristaltic pump. Small diameter wells with a static water level of greater than 25 feet from the top of the casing will be developed using a bailer. Large diameter wells (>4.0") will be developed using a four-inch 1/2 HP stainless steel submersible pump. Regardless of the method, any equipment that is placed in a well must be steam cleaned.
- 5. The pump or tubing should be kept at the top of the water column so as to ensure that the water is being drawn through the entire length of the screen. However, when cutting the tubing, it must be cut to a length that will reach to bottom of the well for sampling purposes.

- 6. The pump rate should be set, when possible, so that the well will not be dewatered, thereby delivering a constant yield. The water level should not be allowed to drop below the depth of the top of the screen. If a flow rate cannot be maintained, follow low yielding well development procedures.
- 7. Upon completion of development, the well is ready to be sampled. Since the water present in the column is representative of the formation water, it can be sampled immediately after the well has sufficiently recovered. If it has not recovered, it can be sampled up to a maximum of seven days from time of completion.

Low Yielding Wells

- 1. Record all physical information as listed on the header of the well development field data sheet.
- 2. Determine and record the static water level and the depth to the bottom of the well.
- 3. Determine the volume of water present in the column by taking the difference between the static water level and the depth to the bottom of the well times the volume per foot of casing based on its diameter.

1.5" = 0.09 gals/ft.

2.0'' = 0.16 gals/ft.

4.0'' = 0.65 gals/ft.

6.0" = 1.6 gals/ft.

8.0'' = 2.6/gals ft.

4. Small diameter wells (<4.0") with a static water level of less than 25 feet from the top of the casing will be developed using a peristaltic pump. Small diameter wells with a static water level of greater than 25 feet from the top of the casing will be developed

using a bailer. Large diameter wells (>4.0") will be developed using a four-inch 1/2 HP stainless steel submersible pump. Regardless of the method, any equipment that is placed in a well must be steam cleaned.

5. Evacuate the well two times.

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- 6. Record the recovery rate of the well following the first evacuation. The next evacuation can begin as soon as the well has recovered to 90% of the original volume or after 24 hours.
- 7. Upon completion of development, the well is ready to be sampled. Since the water present in the column is representative of the formation water, it can be sampled immediately once the well has sufficiently recovered. If it has not recovered, it can be sampled up to a maximum of 7 days from time of completion.

Groundwater Monitoring Well Sampling Procedures

Wells With Static Water Levels <30 Feet

- Determine the static water level with a water level indicator and record depth to water.
 Record reference point, i.e., top of casing, ground, etc.
- 2. Determine depth to bottom by lowering a water level indicator to bottom. Record reference point.
- 3. Measure and record height of casing

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- 4. A clean sheet of plastic should be placed around the well to be sampled so that there is a clean surface on which to place sampling equipment.
- 5. Set up peristaltic pump on wells that contain Teflon tubing. Those wells that do not contain tubing may be bailed manually with a stainless steel bailer attached to a nylon cord. Bailer and cord must be steam cleaned before they are used in a well.
- 6. Attach Teflon tubing (dedicated to that boring) and start purging, using peristaltic pump. If boring is air rotary type (diameter 6-8 inches), use a submersible pump to purge. Pump should be cleaned before use.
- 7. Sampler must wear new disposable latex gloves while bailing or inserting Teflon tubing into a well.
- 8. Purge three volumes of the well as determined by diameter of the well and the difference between the static water level and the depth to bottom, using the purging procedure appropriate for that well. If well yields less than three calculated volumes, purge until borehole is evacuated. Formula used to determine volume: ____ gal/ft. x (depth to bottom depth to water before purge).

- 9. After purging, determine and record the static water level. Allow well to recover to 90% or greater of the original water column depth. If recovery is proceeding slowly, go on to another well. The well must be allowed to recover before sampling, but the maximum allowable elapsed time between purging and sampling cannot exceed 7 days.
- 10. Once the well has recovered, begin sampling from the bottom one-third of the water column. Record sample depth. Collect a sample in the properly preserved bottle, equal to 1/3 of the total required sample volume. Cap appropriate bottles securely, making sure that there are no air bubbles present for VOC samples. If air bubbles are present, refill until they are removed. VOC samples should be collected first with a stainless steel bailer. All metal samples must be field filtered and placed in a plastic liter bottle preserved with nitric acid. Repeat for the middle 1/3 and the upper 1/3 of the column.
- 11. After collecting samples in bottles, collect in a clean bottle 1/3 of the bottle's total volume to be used later for taking field measurements.
- 12. Determine and record the pH, specific conductivity, and temperature of the water in the well directly, using an instrument capable of being placed down the borehole after sampling is complete. Determine and record the static water level after sampling.
- 13. Upon completion of the sampling, place all tubing into a large plastic bag labeled for that particular well.
- 14. Pack and label all samples in a cooler for analysis by laboratory. The bottles should be labeled with the site location, date, time, sampler's initials, analysis parameters, and sample I.D. that includes the date and well I.D.
- 15. A laboratory chain of custody must be filled out completely and properly.

Wells With Static Water Levels >30 Feet

- Determine the static water level with a water level indicator and record depth to water.
 Record reference point, i.e., casing, ground, etc.
- 2. Determine depth to bottom by lowering a water level indicator to bottom. Record reference point.
- 3. Measure and record height of casing.
- 4. A clean sheet of plastic should be placed around the well to be sampled so that there is a clean surface on which to place sampling equipment.
- 5. If the well is 4" in diameter or larger and has a high yield, go to step 10.
- 6. Lower bladder pump and tubing into boring and connect to air pump.
- 7. Make sure hoses are connected to both pump air line and controller.
- 8. Start air compressor, regulate flow via the controller.
- 9. Regulate water flow with controller.

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- 10. Use submersible pump to purge. Pump should be steam cleaned before use.
- 11. Purge three volumes of the well as determined by diameter of the well and the difference between the static water level and the depth to bottom. Use the purging procedure appropriate for that well. Formula to determine volume: ___ gal/ft. x (depth to bottom depth to water before purge).
- 12. After purging, determine and record the static water level. Allow well to recover to 90% or greater of original water column height. If recovery is proceeding slowly, go on to another well. The well must be allowed to recover before sampling, but the maximum allowable elapsed time between purging and sampling cannot exceed 7 days.

- 13. Once the well has recovered, begin sampling using a steam cleaned teflon or stainless steel bailer from the bottom 1/3 of the water column. Record sample depth. Based on analyses to be performed, collect a sample in the properly preserved bottle, equal to 1/3 of the total required sample volume. Cap bottles securely. For volatile samples, fill 2 VOAS at each 1/3 of well volume (lower, middle, and upper), making sure that there are no air bubbles present. If air bubbles are present, refill until they disappear. If well shows significant drawdown, then the VOAS should be taken first.
- 14. For wells with a water column of less than 5 feet, only 2 VOAS need to be taken. For those with a water column between 5 and 10 feet, 2 sets of VOAS or 4 all total need to be taken. Any well with a water column greater than 10 feet will need to have VOAS taken at all three levels for a total of 6.
- 15. After collecting samples in bottles, collect in a clean bottle 1/3 of the bottle's total volume to be used later for taking field measurements.
- 16. Repeat steps 13 and 14 for the middle 1/3 and the upper 1/3 of the column. Record sample depths.
- 17. Determine and record the static water level after sampling.
- 18. Determine and record the pH, specific conductivity, and temperature of the water in the borehole directly, using an instrument with a probe capable of being placed into the borehole after sampling is complete.
- 19. Upon completion of the sampling, the bladder pump and tubing/submersible pump should be rinsed inside and outside and placed in a large plastic bag.
- 20. Pack and label all samples in a cooler for analysis by a laboratory. The bottles should be labeled with the site location, date, time, sampler's initials, analysis parameters, and sample I.D. that includes the date and well I.D.

21. A laboratory chain of custody must be filled out completely and properly.

Quality Assurance/Quality Control

for Groundwater Samples

- 1. Development and sampling protocols will be strictly followed.
- 2. Trip blanks are to be carried in the same container as collected samples and will be analyzed as required. A new trip blank should be obtained from the lab each three to seven days.
- 3. Field blanks will represent approximately 5% of all samples taken. The location for the field blank will include both "clean" wells and those known from previous sampling to contain VOC's.
- 4. These samples will be included on the chain of custody and will be surrendered to the laboratory in the same fashion as the other samples taken that day. Some will be blind and others will not be.
- 5. Split samples will be taken and sent to different laboratories for approximately 2% of the samples.
- 6. Blind replicates will be taken for approximately 1% of the samples.

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7. All unreasonable results will be challenged and the laboratories will be visited to review in-house QA/QC and inspect equipment.

APPENDIX C

GROUNDWATER CHEMISTRY DATA

IBM POUGHKEEPSIE · GROUNDVATER MONITORING PROGRAM WELL NO. A40S

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WELL		A40S	A40S	A40S					
LAB ID		08/26/88	09/07/88	09/20/88		1980 - 3rc	1980 - 3rd Ortr 1988		
LAB Parameter	UNIT	ENVIRO.	68231003 ENVIRO.	68695005 ENVIRO.	HAX	X	NO. PTS.	HO. BMRL	NO.
1) VOLATIIE COCANICE CONSTRUCTIONS	# # # ·		96 97 97 91 93 94 91 91 91 91 91 91 91 91 91 91 91 91 91	28 91 11 11 11 11 11 11	H H H H H H H H H H H	11 14 14 14 14 14 14	# # # # # # # # # # # # # # # # # # #	11 10 10 10 11 11 11 11 11 11	
Benzene	1/01	O Leon	82	Š	ć	6	•	•	•
Bromodichloromethane	1/6n	NO 1.0	ND 01.0	KN KD21 O	0.0	9.0		0	7
Bromoform	7/95	No.1.0	o tecu	0.160	9.0	0.00	1 1	-	~ .
Bronomethane	1/bn	ND 1.0	0.160%	o tecu	0.0	0.00	~ ^	-	m 1
Carbon tetrachloride	7	o teon	0.100	0.100	0.00	0.00	~ 1	o (
Chlorobenzene	7	0.1608	0.100	0.100	0.00	0.00	m i	0	m :
Chloroethane	7	0.100	0.10	KU81.0	00.00	0.00	m i	0	m
2-Chloroethylvinyl ether	7/67	No 1 con	0.160%	0.100%	0.50	0.00	m r	0 (2
Chloroform	7	0.1001	0.00	0.00	0.00	0.00	∽ :	0	m
Chloromethane	7,60	0.10	0.100	ND41.0	0.00	0.00	m	0	-
Dibromochloromethane	7	0.100	NO. 1001	0.150%	0.00	0.00	m	0	
1,2-dichlorobenzene	- K	0.100	0.160K	0.150%	0.00	0.00	m	0	
1,3-dichlorobenzene	5	NO. 160	NDS1.0	ND ST. O	0.00	0.00	m	0	~
1.4-dichlorobenzene	1 6n	0.160%	NDal.0	NDal.0	0.00	0.00	m	0	2
Dichlorodi (luoromethan	765 7	NDal.0	NO 01.0	ND31.0	0.00	0.00	m	0,	
1 1-Dicklososthan	1/6n	4 2	ND 21.0	ND@1.0	0.00	0.00	2	0	~
1 2.Dicklorootkane	1/gn	87	51	71	87.00	51.00	m	0	
1 to ich occupation)/Bn	N031.0	NO21.0	ND 21.0	0.00	0.00	۲,	0	
1 2. Trans. distillant to	ng/f	NDal.0	ND@1.0	ND31.0	0.00	0.00	M	0	
1.2. It ans alcoloroethylene	1/gn	15	19	23	23.00	15.00	M		n C
1,2.Ulchloropropane	1/6n	Noa1.0	NOD1.0	Noa1.0	0.00	00.00	~	· c	
tis-1,3-Ulchloropropene	ng/f	Noa1.0	ND31.0	ND31.0	0.00	00.0	m	· c	· ·
ti ans 1, 3 Ulchi oropropene	ng/f	NDal.0	ND 21.0	ND31.0	0.00	0.00		· c	↑ ►
EINYIDenzene	ng/l	NDa1.0	NA	NA	0.00	0.00	, -	o c	· ·
nethylene chloride	1/6n	ND 31.0	Noa1.0	O LEON	00.0	00.0	- 14		- P
1, 1, 2, 2 · letrachloroethane	ug/J	NDal.0	Noa1.0	NDa1.0	0.00			o c	~ ~
letrachioroethylene	ug/l	NDal.0	1:1	N031.0	1.10) M	o c	
Totache 1 1 2 mai - Elisa 1 mai 2 mai	1/6n	=	NA	ИА	11.00	11.00	-	· c	
1,1,2,7trichloro:1,2,2,trifluoroethane	ng/l	ND 31.0	NDal.O	ND21.0	0.00	0.00	m	0	
1 1 2. Trichloroothan	1/6n	Noa1.0	ND21.0	ND@1.0	0.00	0.00	m	0	
Trichloroethylese	1/6n	N091.0	ND 91.0	NDal.0	0.00	0.00	m	0	M
Trichlorofluoromethana) fin	N021.0	Noa1.0	NDa1,0	0.00	0.00	٣	0	
Vinvl chlorida	760	O. Leon	N0a1.0	ND21.0	0.00	0.00	m	0	~
Xvienes Total	1/6n	O. Leon	N021.0	ND31.0	0.00	0.00	m	0	
7) OIL AND CDEAST	1/6n	NDal.0	Y X	НА	0.00	0.00	-	0	-
Fuel Dil #1	•		;						
=	\ \ \ \ \	NO SO. 1	NA NA	НА	0.00	0.00	_	0	
; ;	\ \ \ \ \	ND30.1	KA	ИA	0.00	0.00	-	0	
- -	\ \ \ \	ND 20.1	X.A	NA	0.00	0.00	_	0	
	\ \ \ \ \	ND 30.1	KA A	HA	0.00	0.00	-	0	
5 6	<u> </u>	ND 20.1	NA	KA	0.00	0.00	_		
5	<u> </u>	หอล0.1	NA	NA	0.00	0.00			
	mg/l	ND 30.5	N.V.	NA	00.00	0.00		. 0	
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IBH POUGHKEEPSIE - GROUNDWATER MONITORING PROGRAM WELL NO. A41S

WELL DATE LAB 1D LAB PARAHETER		A4 08 67 67 EN	A415 08/26/88 67912004 ENVIRO.	A41S A41S A41S 08/26/88 09/07/88 09/20/ 67912004 68231004 686950 ENVIRO. ENVIRO		88 01 ', HAX	t	1980 - 3rd artr 1988: NO. NO HIN PTS. BHR		ко. N.D.	
1) VOLATILE ORGANIC COMPOUNDS Benzene			ND:01.0	XA		0.00	00.0	-	0		
Bromodichloromethane	S :		ND 21.0	ND 21.0	N0.01.0	0.00	0.00	m 1	0 (mı	
Bromomethane	ă s	Ug/1 NO	0.160%	0.160N	NO 21.0	0.00	9.0	~ F	0 0	m r	
Carbon tetrachloride	5 3			ND 01.0	ND 31.0	0.00	80) H	-	n r	
Chlorobenzene	ïŏ	-	NDal.0	ND 0.1 CON	NO 01.0	0.00	0.00	m	0	n M	
Chloroethane	Š		NDa1.0	Noa1.0	моа1.0	0.00	0.00	m	0	n	
Z-Lhloroethylvinyl ether Chloroform	5° 5		N021.0	Noa1.0	No 1.0	0.00	0.0	m r	0 0	M F	
Chloromethane	5' S	ON 1/60	Moal. 0	ND 31.0	ND 1.0	0.00	0.00	~	- -	n r	-
Dibromochloromethane	Š		0.1eon	No.1.0	Noa1.0	0.00	0.0	m	0	m	•
1,2-dichlorobenzene	Š		NDal.0	ND 21.0	0.1edN	0.00	0.00	m	0	m	
1,3-dichlorobenzene	Š.		ND 31.0	ND 21.0	Noal.o	0.00	0.00	m i	0	M I	
l, 4. dlcnlorobenzene Dichlorodifluoromethane	Ď.		MDal.0	Moal.0	Noa1.0	0.00	0.0	m c	0 0	м	
1,1-Dichloroethane	5 5	08/1/bn	KA NDa1.0	1.2	ND 0.10	1.20	9.0	v m		۷ ۸	
1,2-Dichloroethane	Š	_	Q.TGON	ND@1.0	ND31.0	00.0	0.00	m	0	m	
1,1.Dichloroethylene	5	_	ND31.0	Noal.O	0.1con	0.00	0.00	~	0	M	
1,2.Trans-dichloroethylene	ž i		Noa1.0	Noa1.0	N021.0	0.00	0.00	m	0 (m I	
cis-1.3-0ichloropene	5 5	U9/1 NO	NO. 1 . 0	ט. ופטא	0.160%	0.00	8.0	~ ~	-	~7 P	
trans-1,3.0ichloropropene	ה ה י		ND 31.0	Noa1.0	ND 0.1 GON	0.00	0.0	' M	0	ח ר	
Ethylbenzene	Ď		ND31.0	NA	K A	00.0	0.00	-	0	-	
Hethylene chloride	j.	_	ND31.0	ND@1.0	0.1ean	00.0	0.00	~	0	m	
1, 1, 2, 2. Tetrachloroethane	5		ND 31.0	M031.0	1501.0	0.00	0.0	m r	0 (m i	•
Toluche		מפיין אני	Koal.o	NO. LON	NO PIN	00.0	8.0	n -		-1 -	
1,1,2, trichloro-1,2,2, trifluoroethane	_		ND 31.0	ира1.0	NDa1.0	0.00	0.00	· m	0	- m	
1, 1, 1. Trichloroethane			ND@1.0	1.6	ND31.0	1.60	0.00	m	0	2	
1, 1, 2. Trichloroethane)		XD21.0	0.160	Mpa1.0	0.00	0.0	m 1	0 (mı	
Tricklend Control of the	-			NO 01:0	0.100	9.0	0.00	~ •	0 (~ ı	
Vioci chlorida	:		MD41.0	NO. 10.01	0.100	0.00	3 8	~ r	-	~) t	
Xylenes Total	9 2	7/50	0.160%	TAN TO SEL		8.0	8.6	n -	-	^ -	
7) OIL AND GREASE)	.	•) •	3	-	•	-	
110	כ		ND 20.1	K.A	NA NA	0.00	0.00	-	0	-	
<u> </u>	7		нра0.1	¥	HA	0.00	0.00	-	0	-	
= =	3		ND 20.1	¥ :	K A	0.00	0.0	- •	0 (- ·	
FUEL DIL #5	.	Z 3	MD20.1	XX XX	X :	0.00	9.0		0 0	- +	
; ;	5		N0 90 . 1	K K K	Α Α	0.00	0.00		- C		
			ND 30.5	X X	X.X	00.00	0.00	-	, o	-	

IBM POUGHKEEPSIE • GROUNDUATER HONITORING PROGRAM WELL NO. A428

						1 1 1 1							
WELL DATE			A42S 08/26/88	A42S 09/07/88	A42S 09/14/88	A42S 09/14/88	A42S		1080	8801 4420 722 7 0805	a		
LAB 10			67912003	68231003	68523001		68695002		0061	NO.	NO.	NO.	
PARAHETER		TIMO		ENVIRO. ENVIRO.		ENVIRO.	ENVIRO.	НАХ	Z Z	PTS.	BMRL	N.D.	
1) VOLATILE OR		1 1 1 1 1			## ## ## ## ## ## ## ## ## ##	96 87 83 84 80 80 81 81 82 83	 	11 11 11 11 12 12 12 14 14 14 14 14 14 14 14 14 14 14 14 14	14 16 16 11 11 11 11 11		# # # # # # # #	11 11 11 11 11 11 11 10 11 11 11	11
Acrolein		ng/l	KA	ИА	ND 31000	NA	. AM	00.00	0.00	-	0	-	
Acrylonitrile	3	ng/l	NA	NA A	NDa1000	HA	NA	0.00	00.00				
Benzene	3	ng/t	NDato	NA	ND350	НА	KA	0.00	0.00	. 2	0	۰ ۸	
Bromodichloromethane	٥	ng/l	NDa10	NDa10	ира50	HA	ND 310	0.00	00.00	1 7	· c	1 7	•
Bromoform	J	ng/l	พออา0	NDa10	ND 350	NA	моэ10	0.00	00.00	- 3		• •	
Bromomethane	נ	1/6n	ND 210	ND 310	ND 0 5 0		ND 310	0.00	0.00	- 4	· c	٠ ،	ý
Carbon tetrachloride	נ	ng/l	NDa10	NDato	ND 350		OLCON	0.00	00.00	- 4) C	1 4	
Chlorobenzene	3	ng/l	NDa10	ND 310	ND 350	NA	NDalo	0.00	0.00	4	· c	1 4	
Chloroethane		ng/l	43	NDato	ND 250	NA	ира10	43,00	00.00	• •		M	
2.Chlorocthylvinyl ether		ng/1	ND@10 .	ND@10	ND 350		Noato	0.00	0.00	. 4		1 4	
Chloroform	J	ng/l	N0210	15	ND 350		33	33.00	0.00	4	· c	۰ ۸	•••
Chloromethane	3	ng/l	พออา0	NO 310	NDa50	KA	ND310	0.00	0.00	3	· c	۱ ۷	
Dibromochlaromethane	3	ug/l	NO 910	ND@10	NO 350		ND@10	0.00	0.00	4	· c	7	
1, 2-dichlorobenzene	3	ng/f	ND@10	NDa10	NO 050	ND 010	ND 310	0.00	0.00	· Lin	c		
1, 3-dichlorobenzene	3	l/6n	ND 310	ND 0 10	ND 350		ND@10	0.00	0.00	. 10			
1,4-dichlorobenzene		ug/l	NDa10	ND 310	ND 250		NOS10	0.00	00.00		· c		
Dichlorodifluoromethane		ug/l	NA	NDa10	KA	•	ND910	0.00	0.00	۰ ۸	· c	, (
1, 1.Dichloroethane	J	ug/l	610	510	790		290	790.00	510.00	: ~4	· c	. c	
1, 2-Dichloroethane	3	ng/l	Noa10	NDa10	ND 250		ND@10	0.00	0.00	4		.	
1, 1.Dichloroethylene		ng/l	ND@10	N0.010	ND 350	HA	ND 310	0.00	00.00	- 4		- 4	
1, 2. Trans-dichloroethylene		J/Gn	7.4	59	52	NA	67	74.00	49.00	• •	0	· c	
1, 2.0 ich loropropane		ug/l	N0@10	N0a10	ND 050	HA	ND 310	0.00	00.00	3	· c	۰ ۷	
cis-1, 3-Dichloropropene		ng/l	Noa10	N0 210	ND 250	KA	ND210	0.00	0.00	- 4	0	. 4	
trans.1,3-Dichloropropene		ng/l	ND 210	ND@10	NDa50	KA	ND@10	0.00	00.0	- 4	0	- 7	
Ethylbenzene	2	ng/l	ND 310	ИА	NDa50	NA	NA	00.00	0.00	~ ~	0	~ ~	:
detaylene chloride,		1/gn	No 310	ND 310	21	NA	ND310	21.00	0.00	4	0	~	
1, 1, 2, 2 · letrachloroethane		1/6n	ND 310	NDato	ND950	MA	No a 10	0.00	0.00	7	0	7	
Toluçõe	. و	1/6n	01608	01608	ND 050	XX:	NDalo	0.00	0.00	7	0	7	,
1 1 2 .trichloco.1 2 2 trifluorosthans		1/60	39	X X	<u>.</u> .	NA :	MA	51.00	39.00	2	0	0	
1.1.1.Trichloroethane		1/60	01601	NO. 10	NA COCOL	X .	Noaro	0.00	0.00	m·	0	м.	
1, 1, 2-Irichloroethane		1/67	Monto	NO B TO	NO. SO	.	0.00	0.00	0.00	.	o (J .	
Trichloroethylene		7/65	ND 010	ND 010	NO SCO	(a	01000	0.00	9.0	٠ د	-	3 ·	
Irichlorofluoromethane		ug/l	ND 310	Noalo	ND 050	C 2	01000	8.0	0.00	3	-	3、	
Vinyl chloride	_	ng/l	23	NDa10	ND 350	NA NA	ND 010	2,50	8.0	5 ×		1 M	
Xylenes, Total		1/6n	52	HA	ND 350	KA KA	KA	52.00	90.0	, ,	-	- r	
	2) HETALS							2			•	-	
Antimony (Sb)		mg/l	NA	HA	ND 30.060	HA	X.A	0.00	00.00	-	c		
Arsenic (As)	•	1/6w	KA	ΑN	0.050	KA	HA	0.05	0.05		o	- c	
Beryllium (Be)		1/ <u>6</u> ш	NA	NA	ND 30.005	HA	KA	0.00	0.00	-	0	,	
Cachium (Cd)		mg/l	¥2	ИA	ND 30.002	HA	NA	0.00	0.00	-	0	-	
Chromium (Cr.)	•	mg/l	NA	ИА	0.03	NA NA	HA	0.03	0.03	-	o 0	. 0	
Copper (Cu)	-	1/6w	Y.Y	NA	ND 00.05	NA	NA	0.00	0.00	-	0	-	
Lead (PD)	- '	1/6m	4 :	NA:	ND 30.005		٨A	0.00	0.00	-	0	-	
Nickel (Ni)	- •	1/6m	Υ	Y :		XX:	NA :	0.00	0.00	-	0	-	
	-	1/6	ξ.	¥ ¥	ND 90 . 05	XX	XX	0.00	0.00	-	0	-	•

IBM POUGHKEEPSIE - GROUNDWATER MONITORING PROGRAM WELL NO. A43S

					ארוי מסי	27.5				
VELL Date		A43S	A435	A43S						
LAB 10		67912002	09/0//88 682321002	09/20/88 68695003		1980 - 3r	1980 - 3rd Ortr 1988 NO.	8 E	. ca	
LAB Paraheter	E N	ENVIRO.	ENVIRO.	ENVIRO.	НАХ	M I N	P1S.	BHRL	N.D.	
1) VOLATILE ORGANIC COMPOUNDS	## ## ## ##		4 H H H H H H H H H H H H H H H H H H H	11 11 11 11 11 11 11 11	60 61 61 61 61 61 61 61 61 61 61 61 61 61		## ## ## ## ## ## ## ##	# # # # # # # # # #	11 11 11 11 11 11	
Benzene	1/6n	0.1edx	KA A	NA NA	0.00	0.00		0	-	
Bromodich Lorome than e	ug/l	NDal.0	NO.1.0	NDa1.0	0.00	0.00	m	0	· M	
Bronoform	1/60	Noa1.0	NOa1.0	ND 0.10	0.00	0.00	m	0	m	
Bromomethane Crabon Assessing	1/gn	NDa1.0	NO31.0	ND 21.0	0.00	0.00	'n	0	m	
Larbon tetrachloride	1/gn	Noa1.0	ND31.0	Noa1.0	0.00	0.00	m	0	m	
Chloroothaa	1/gn	ND 0.10	ND 31.0	Noa1.0	0.00	0.00	M:	0	м	
2.Chlorostholving atton	765 1	2.3	7.7	Noa1.0	7.70	0.0	m 1	0	-	
Chloroform	7,60	0.1604	NO.1.0	0.1601	0.00	0.0	m r	0 (m I	
Chloromethane	7,61	0.160%	0.160	0.1001	3.5	9.0	~ ~	-	~ 1	
Dibromochloromethane	7,65	0.160	0.1668	0.100	9.0	9.0	n r	-	~ I	
1.2-dichlorobenzene	7	0.100	0.100	0.100	8.6	0.00	~	۰ د	~ე	
1,3-dichlorobenzene) /Sn	20.100	0.1664	0.160	8.0	9.0	∽ Ի	-	~1 t~	
1,4-dichlorobenzene	/65 1/bn	No 1 o	No. 1 edw	0.160	8.5	8.6	1 K	-	^ ~	
Dichlorodifluoromethane	/bn	XA	Noa1.0	Noa1.0	00.0	80	, ₍	o c	1 0	
1,1.Dichloroethane	ug/l	84	84	2	84,00	2.00	'n	0	3 C	
1,2-Dichloroethane	ug/l	ND31.0	ND31.0	ND31.0	0.00	0.00	M	0) M	
1, 1.Dichloroethylene	ug/l	ND34.0	NDal.0		0.00	0.00	m	0	m	
1,2.Trans-dichloroethylene	ug/l	ND31.0	ND31.0		00.0	0.00	m	0	m	
1,2.01chloropropane	ng/l	Noal.0	N031.0		0.00	0.00	~	0	m	
trans.1 7. Nicklement	1/6n	0.1eox	Noal.0	Noa1.0	0.00	0.00	m	0	м	
Frhylbenzene	1/6n	0.100	Moal.0	_	0.00	0.0	m ·	0	m	
Hethylene chlorida	1/6n	NO 21.0	NA URO4		0.00	0.0	-,	0 (- 1	
1.1.2.2-Tetrachloroethane	765	0.1001	0.100	NO. 1	0.00	0.00	~ ↑ Ի	0 (M I	
Tetrachloroethylene	1/60 1/00	0.1608	No. 1 cox	Nos.	90.0	3 5	^ ~	-	~1 P	•
Toluene	, 6n	Noa1.0	NA N	NA.	0.00	0.0	د	-	- n	
1,1,2, trichloro-1,2,2, trifluoroethane	1/gn	ND 0.10	NO31.0	NO 01.0	0.00	0.00	· M	0	- ••	•
1, 1, 1 Trichtoroethane	1/6n	NDal.0	ND31.0		0.00	0.00	m	0	m	
I, i, Z. irichloroethane Irichloroethan	ug/l	N0.1.0	N0.1.0	Noa1.0	0.00	0.00	m	0	٣	
Tricklesstations	7 i	ND31.0	O. LEON		0.00	0.00	m	0	m	
Visus ablasias	1/gn	ND91.0	Noo1.0		0.00	0.00	m	0	m	
ייווער כוונסרומפ	1/6n	0.100	NO 01.0	=	0.00	0.00	m	0	m	
7) OIL AND CREASE	1/6n	0.160%	¥x	¥ X	0.00	0.00	-	0	-	
Fiel Oil #1	7	•	. :	;			•	4		
1 10	5 5	100 Leon	X :	X 2	9.0	0.0	.	0 0	, ,	
! !	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	0.166	(<	ξ 2	8.6	0.0	- •	-		
<u>.</u>	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	MO31.0	(4	(()	00.0	8.0				
	1 7 5	Noal.0	N.	ИĄ	0.00	0.0	. ,_	0		
Fuel 0il #6	1/3	NO31.0	Y Y	ΝA	0.00	00.0	-	0	,	
Oll & Grease	₩}/Г	1.5	۲A	МA	1.50	1.50	-	0	0	

IBM POUGHKEEPSIE - GROUNDWATER MONITORING PROGRAN WELL NO. A44S

					WELL NO.	. A44S				
NELL		A44S	844S	577¥						
DATE		08/26/88	09/07/88	09/20/88		1080 - Total Cart 4000	000			
LAB ID		67912001	68231001	68695004		10	מערנד ואָט אס.		: OR	
PARAHETER	TINO.	ENVIRO.	ENVIRO.	ENVIRO.	HAX	HIN	PIS.	BHRL	N.D.	
1) VOLATILE ORGANIC COMPOUNDS	11 22 12 13 14		66 27 44 47 47 47 47 48 48 48 48 48 48 48 48 48 48 48 48 48	31 10 31 30 31 41 41 41 41	# # # # # # # # # # # # # # # # # # #	11 11 11 11 11	# # # # # # # # # # #	# # # # # # #	68 68 69 69 69 69 69 69 69 69 69 69 69	
Benzene	1/60	NDa1.0	NA.	N.A.	6		•			
Bromodichloromethane	7/60	NDa1.0	NO 1 C	-	0.00	0.00	 1	0	-	
Bromoform	7/60	Noal.o	No. 1 GOX	0.100	0.00	0.00	m	0	m	
Bromonethane	7	No 1 con	0.1667	9.00	0.00	0.00	M	0	m	
Carbon tetrachloride	. 1/61	o ledk	0.1668	0.1001	0.00	0.00	m	0	m	
Chlorobenzene	7	0.100	0.00	0.190	0.00	0.00	m	0	m	
Chloroethane	· · ·	0 0 0	0.100	N021.0	0.00	0.00	m	0	M	
2-Chloroethylvinyl ether	7 60	0.00	N091.0	Noa1.0	0.00	0.00	m	0	M	
Chloroform	5	0.160	Noal.O	NDal.0	0.00	0.00	m	0	۰,	
Chloromethane	1/6n	ND41.0	ND91.0	NO 31.0	0.00	0.00	m	0	· •	
Dibromochloromathana	1,60	0.160%	Noa1.0	ND 21.0	0.00	0.00	M	· c	· ~	
1 2 dichloroberane	5	MO31.0	N091.0	ND 21.0	0.00	0.00	M) (*	
1 3-dirhlorobenzene	1/6n	ND31.0	No.1.0	ND 31.0	0.00	0.00	m		۰ ۳	
1 4-dichlorobonzone) 6	0.1cox	No.1.0	ND31.0	0.00	0.00	M	o C	n M	
Dichlorodif Horomathan	76n	0.160N	N091.0	ND@1.0	0.00	0.00	M		1 ~	
1 1.0 ichlocosthane	- F	¥ Y	Noa1.0	ND 21.0	0.00	0.00	~		א נ	
1 2.0 ichloroethana	1/6n	13	6.6	3.7	13.00	3.70	M		ı c	
1.1.0 ichlorosthylese	1/6n	ND 01.0	N0a1.0	NDal.0	0.00	0.00	m) ~	
1 2-Trans-dichloroathylone	\6n	NDal. U	Noa1.0	ND 91.0	0.00	0.00	M		۰ ۳	
1 2.0 ichloropropana	1/6n	Noal.o	Noa1.0	ND 91.0	0.00	0.00	m	o c	س د	
cis-1,3-0 ich oroproses	1/6n	ND31.0	ND21.0	ND31.0	0.00	0.00	m	o 0	n r	
trans. 1 3.0 ich orongone	1/6n	MDal.0	0.160%	N021.0	0.00	0.00	m	. 0) ~	
Ethylbrozene	7 g	N031.0	ND 21.0	ND@1.0	0.00	00.00	m	· c	۳ r	
Hethylone obtonide	765	Noal.o	NA.	KA	00.00	0.00	, -	o) -	
1 2 2:Tetrachlocostbace	1/gn	NDal.0	N0 91.0	ND 01.0	00.0	0.00	· M	o	- ~	
Tetrach occeptive one	1/6n	NO.1.0	N0a1.0	ND21.0	0.00	0.00	· M	· c	۰ ۳	•
Toluene	1/6n	0.1601	Noal.o	ND 01.0	0.00	0.00	,	0	· ••	
1.1.2 trichloro-1 2.2 trifluoroathana	165	20 TO 10 TO	NA.	NA	0.00	0.00		0	· -	
1,1,1-Trichloroethane	760	0.100	ND31.0	NO 91.0	0.00	0.00	m	0	· M	
1,1,2.1richloroethane	7/65	No.1.o	0.100	20 . CO.	0.00	0.00	m	0	m	
Trichloroethylene	7	Monto	0.100	0.100	0.00	0.00	m	0	m	
Irichlorofluoromethane	1/67	No. 1 edk	0.160%	0.1001	0.00	0.00	m i	0	M	
vinyl chloride	7/8/	No. 1 cox	0.150%	0.00	0.00	0.00	m	0	m	
Xylenes, Total	1/6/1	No 1 . O	9.		0.00	0.00	m	0	٣	
7) OIL AND GREASE	ĥ		Ç	ť z	0.00	0.00	-	0	-	
011 #1	N/I	ND 20.1	KA	Ϋ́	0	0	•	•	•	
<u>.</u>	٦ ا	ND 20.1	NA	X X	8.0	86		- (- .	
<u>=</u> :	٦ ا	ND 00.1	N.A.	NA.	80.0	6.0	- •	- (
<u>.</u>	こ	ND 20.1	KA	XX.	8.0	8.6		- (- .	
= :	715	NDBO.1	KA	NA	80.0	86		- (
Fuel 011 #6	1/In	ND 20.1	NA	* A.	0.0	8.0		-	-	
Ull & Grease	mg/l	4.0	NA	NA	7.00	20.7		- 6	- (
_) - -	•	>	>	

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	į.	e e	\	00.0	60.0		0.1952	27	RDSI '0	1/22	i,i,2,-trichloro-i,2,2,trifluoroethane
	ſ	0	[00.0	66.0	0.1508		11	2.09UE	1/52	Tolueze
	Ţ	C	Ī	00.0	00.0	17	25			1/55	Tetrachistoethylese
	7	6	;	66.0	99.9	6.1968	0.19GE	0.1522	3.0908		#4541967261797-1,1,1 #44196726174797
	[0	£	00.00	0.00	CLIBER	0.19EE	11		1/52	
	[•	9	Į.	00.0	66.0	0.1508	2057'0	¥¥	0.1958	[/53	Zethylene chloride
•	Ţ	0	ī	00.0	66.0	11	27	11	2.08EE	1/52	ztazibenzeze
	ſ	ū	ξ	90.0	6910	REST'O	2261.0	27	OLISON	1/55	trans-i,3-Bichloropropese
	·	0	ţ	00.0	6010	0.19CE	0.1858	11	6.1968	1/5a	enaqoiqoioldai@-E,i-zia
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