water column in the well, resulting in a positive air flow to the subsurface through the well's slotted pipe section. A log of the AIS system performance during the pilot testing is provided in Table 2.

On October 4, 1994, the AIS blower was run for about 3 hours. With the AIS blower providing 130 inches of water pressure, sparging was confirmed in each AIS line using a thermal anemometer to measure air flow. Subsequently, the blower pressure was reduced to about 100 inches. At this pressure, the flow rate in each of the AIS lines was adjusted to obtain a maximum balanced flow rate of 100 feet per minute (fpm). Following the first day of testing, the AIS was shut off for 48 hours to allow the air injection wells to completely recharge with groundwater. The AIS was then restarted to verify that that sparging was achieved at this lower blower pressure and that the flow rates in the 12 lines remained balanced at 100 fpm. The velocity data listed in Table 2 for October 6, 1994, indicate that sparging was achieved in each well, although the flow rates were no longer balanced. Specifically, the flow rates had increased to a maximum of 150 fpm in the AIS wells to the north of the technical service facility, including AIS Wells AIS1 through AIS9. Conversely, the flow rates in AIS Wells AIS10 through AIS12, located directly to the south of the facility, had magnitudes of 50 to 75 fpm. Each well was then reset to a flow rate of 100 fpm, maintaining the blower pressure at 105 inches.

VES Monitoring

The Vapor Extraction System (VES) located at this site consists of three subsurface horizontal vapor recovery lines and four vertical vapor extraction wells. As shown in Figure 2, the vertical wells are located in an array to the north of the technical service facility, and are spaced approximately 30 feet apart along an east-west axis. The horizontal lines extend to the facility's south side, with the three pipe's slotted sections placed in one of three distinct treatment zones. One additional VES line was installed in the subsurface soils to the north of the service facility to accomadate potential system expansion.

The VES system began continuous operation on October 14, 1994, with six of the seven VES lines actively removing vapors. The line connecting to Well VES4 was not opened due to concerns that the asphaltic product observed in this well would be pulled through the pipe and damage the blower. Following 6 hours of operation, Line 3 was also closed after water was recovered in the pipe during monitoring activities. This line was kept closed during the remeainder of the first month to maintain consistent operating conditions for monitoring purposes, but was reopened on November 16, 1994, after water was no longer observed in the line.

Monitoring of the Vapor Extraction System (VES) included the collection of vapor analytical samples from the sampling port installed on the exhaust manifold. Including the sample collected during the pilot test, a total of thirteen vapor samples were collected from the stack exhaust during the first month of operation. Two samples were obtained during the first 24 hours of operation, an additional four samples were taken in the first week, and six samples were collected over the subsequent four weeks. Presently, stack exhaust sample collection is being conducted on a monthly basis.

Prior to sampling, field measurements were conducted to verify that the vapor sample would be representative of the stack exhaust. Approximately every 5 minutes, temperature and flame ionization detector (FID) readings of the stack emissions were recorded. In addition, the velocity of air movement in the stack exhaust and the individual VES lines was measured in inches

of water using an anemometer and/or pitot tubes. Once these parameters stabilized, analytical samples were collected in 1 liter stainless steel cylinders provided by the laboratory.

On October 14, 1994, Vapor Samples VES2 and VES3 were collected from the stack sampling port following 1.5 hours and 6 hours of VES operation. Samples were collected on a daily basis between October 15 and 19, 1994, including samples VES4 through VES7. Due to problems gaining access to the site, a vapor sample was not obtained on October 16. Weekly vapor samples were collected for the following month, with Vapor Samples VES8, VES9, VES12 and VES13 collected on October 28, October 31, November 11, and November 16, respectively. Two additional samples, designated VES10 and VES11, were taken on November 4, 1994, in conjunction with the startup of the AIS for continuous operation. Sample VES10 was obtained immediately before the AIS was started, and Sample VES11 was taken 1.5 hours after the startup. A log of system performance, including dates of sample collection, is provided in Table 1.

In addition to exhaust vapor sampling, system monitoring included measuring performance parameters of the individual VES lines. On October 14, 1994, the temperature, rate of air flow, percent oxygen, and percent LEL were periodically recorded for each line. Over the subsequent four weeks, air flow measurements in the lines were recorded on a regular basis. FID readings were not available during this period since the sampling ports for the individual lines were used for manometer placement. Additional sampling port aperatures were installed by BC Excavating on December 9, 1994.

Air Injection System (AIS) Monitoring

The AIS located at this site consists of twelve active air injection wells with the capacity to add two additional wells. As shown in Figure 2, AIS Wells AIS1 thorugh AIS9 are located to the north of the technical service facility. These nine wells are spaced approximately 16 feet apart along the same axis as the VES wells and are positioned to intercept any petroleum hydrocarbons that might be migrating underneath the building from the former UST locations. The remaining three active wells, AIS10 through AIS12, are located to the south of the service facility in the former UST excavation areas. These three wells were positioned in order to actively remediate the petroleum hydrocarbons remaining in the vicinity of the former USTs. Two additional inactive AIS lines were installed in the subsurface soils to the north of the service facility to accomadate potential system expansion. In order to avoid directing hydrocarbon-laden vapors into the service facility through the AIS-induced subsurface air flow, the remediation system is wired such that the AIS will only operate in conjunction with the VES.

The AIS system began continuous operation on November 4, 1994. Presently, ten of the twelve AIS lines are active. The remaining two lines, connected to wells AIS7 and AIS8, remain closed since VES well VES4 cannot be operated due to the asphaltic product, as detailed above. During the first month of operation, monitoring of the AIS consisted of balancing the individual lines to achieve the desired air flow and measuring the dissolved oxygen concentrations in the AIS wells. A log of the AIS system performance is provided in Table 2.

On November 11, 1994, the ten active AIS lines were adjusted to provide a cumulative air flow of approximately half of that removed by the VES. Based on the VES flow rate of 190 scfm measured on November 11, each AIS line was calibrated to a flow rate of 300 to 325 fpm. The resulting blower pressure of 5.5 psi, or about 150 inches of water, represents approximately 60 percent of the blower's maximum operating capacity. On November 16, 1994, the AIS was shut off and the individual AIS wells allowed to recharge. Two hours thereafter, groundwater samples

were collected from each AIS well to measure dissolved oxygen levels. The oxygen level in each well is listed in Table 2, with values ranging from 4.71 ppm in Well AIS8 to 9.92 ppm in Well AIS9. Concentrations did appear to decrease over the approximately 0.5 hour of sampling, as a second sample collected from Well AIS9 contained 4.91 ppm oxygen, or approximately half the concentration of the first measurement.

Ambient Air Quality Monitoring

Ambient benzene standards of 0.1 ppm and 1.0 ppm for a time-weighted (TWA) 8-hour exposure have been established by NIOSH (National Institute for Occupational Safety & Health) and OSHA /ACGIH (Occupational Safety & Health Administration and the American Conference of Government Industrial Hygienists), respectively. Since this site is located in a primarily industrial area, the less stringent 1.0 ppm OSHA standard will be adhered to.

An ambient air quality monitoring program has been established for this site to verify that the benzene emissions from the VES exhaust stack do not exceed the OSHA standard. During the first month of VES operation, benzene levels in the eleven VES stack exhaust samples ranged from 4.19 ppm in Sample VES1 to non-detectable in samples VES3 through VES11 and VES13. To confirm that the resulting ambient benzene levels are below the OSHA standard, a monitoring program has been established which consists of computer modelling and possible vapor-badge measurements of ambient benzene concentrations.

Computer modelling was conducted using the EPA dispersion modelling program "Screen2" to calculate on-site ambient benzene concentrations resulting from dispersion of the stack exhaust. Site-specific inputs include the target compound (benzene) emission rate, the stack exhaust velocity, stack and receptor height, exhaust and ambient temperatures, and terrain information. These inputs are incorporated in a Gaussian plume model to determine the highest benzene concentration at specified discrete distances over a range of meteorological conditions. Using site-specific parameters measured in October, 1994, the modelling program calculated that a minimum total benzene emission of 1700 ppm from within the exhasut stack was required to raise the calculated maximum ambient plume concentration to 1.0 ppm anywhere within 500 meters radius of the environmental shed.

In contrast, the maximum benzene concentration measured in the stack exhaust had a value of 4.19 ppm. When the Screen2 model was run using this emission rate, the maximum ambient concentration was determined to have TWA value of 0.0025 ppm benzene, located at a distance of 75 feet from the environmental shed. Based on the computer modelling and a safety factor of two, it is assumed that the OSHA TWA benzene standard of 1.0 ppm will not be exceeded provided benzene emissions from the air stripper and the VES stack exhaust remain below 850 ppm.

If vapor samples taken from the stack exhaust do exceed 850 ppm, the remediation system will be shut down and direct measurements will be taken of ambient benzene concentrations. These measurements will be made by placing a single 3M Model 3520 Organic Vapor Monitor Badge at each of three sampling stations positioned around the site, including one upwind station and two downwind stations from the remediation shed. The badges will be exposed for about 2 days and then analyzed for volatile petroleum hydrocarbons (VPH) and volatile aromatic organic compounds (BTEX).

Groundwater Monitoring

Groundwater monitoring at this site consists of quarterly sampling conducted to evaluate the hydrocarbon concentrations remaining in the site's groundwater and the status of the remediation efforts. Presently, five (5) monitoring wells are included in the the monitoring program. The location of Monitoring Wells MW03, MW05, MW06, MW07, and MW08 are plotted on Figure 1.

Baseline groundwater concentrations in the five monitoring wells were obtained from a sampling round conducted on June 27, 1994. The results from these samples, which are detailed in a previous Shannon & Wilson status report, indicate the quality of the groundwater prior to startup of the VES and AIS systems. The first quarterly sampling event was conducted on November 28, 1994. Groundwater samples were collected from each of Monitoring Wells MW03, MW06, MW07, and MW08. A sample was not taken from Monitoring Well MW05 due to a buildup of snow which prevented access to the well. Temperature, specific conductance, pH, and dissolved oxygen values of the water samples were measured in the field at the time of sampling. The results of the purging, water level, pH, conductivity, temperature, and dissolved oxygen measurements for the November sampling event are presented in Table 3. The results of quarterly sampling events will be compared to these baseline values to determine the impact of the remediation system on the site's groundwater.

Laboratory Analyses

For the period of September 30 to November 16, 1994, thirteen (13) vapor samples from the VES discharge stack were collected using stainless steel vapor canisters. All samples were submitted to Commercial Testing & Engineering (CT&E) of Anchorage under Chain-of-Custody procedures and were analyzed for aromatic volatile organics (BTEX) using EPA Method 8020 and volatile petroleum hydrocarbons (VPH) using EPA Method 5030/8015. The results for all vapor canister analyses are listed in Table 4 with the individual laboratory reports included in Appendix A. A historical summary of hydrocarbon concentrations in the VES stack exhaust is presented in Graph 1.

The five groundwater sample collected as part of the first quarterly sampling event were submitted to Superior Precision Analytical Laboratories, Inc., using Chain-of-Custody procedures. Each sample was analyzed for BTEX using EPA Method 602 and diesel range organic compounds (DRO) using EPA Method 3550/8100M. The results for all groundwater analyses are listed in Table 4, with historical summaries of petroleum hydrocarbon concentrations presented for each monitoring well in Graphs 2 through 6. All laboratory reports are included in Appendix A.

Discussion of Results

Soil Vapor - As shown in Graph 1, the petroleum hydrocarbon concentrations in the stack exhaust decreased steadily in the first month following startup of the VES. The VPH concentrations in the exhaust samples ranged from a maximum value of 115 ppm , or 9.15 lb/day, in Sample VES2 to 4.6 ppm VPH, or 0.36 lb/day, in Sample VES13. A notable exception to the decreasing hydrocarbon trend was observed in Sample VES11, which was collected shortly following the startup of the AIS for continuous operation. Sample VES10, collected immediately prior to the AIS startup, contained 5.5 ppm VPH, or 0.42 lb/day. Over the first 90 minutes of AIS operation, the VPH concentration in the VES exhaust more than tripled, as Sample VES11 contained 19.6 ppm VPH, or 1.53 lb/day. The trend in the benzene concentrations generally mirrored that of the

VPH concentrations, with values ranging from 1.92 ppm in Sample VES2 to non-detectable in samples VES3 through VES11 and VES13.

Using the Ideal Gas Law, VPH analytical results, and the calculated daily rate of air flow from the VES, the average daily rate of volatile petroleum hydrocarbon discharge for the operating period from October 14 to November 16, 1994 was computed to be about 3 pounds per day. Approximately 53 pounds of volatile petroleum hydrocarbons were vented from the site's subsurface soil during this period of VES operation. Of this quantity, approximately 30 pounds, or 4.5 pounds per day, were vented by the VES system in the first week of operation.

Groundwater - Detectable BTEX and/or DRO constituents were measured in two of the four groundwater samples collected as part of the November, 1994 quarterly sampling event. Sample MW06W2 contained 0.51 ppm DRO, non-detectable benzene, and 0.0052 ppm total BTEX; and Sample MW08W2 had 10 ppm DRO, 3.0 ppm benzene, and 6.6 ppm total BTEX. no detectable DRO or BTEX constituents were measured in either Sample MW03W2 or Sample MW07W2.

It is evident in Graph 4 that the DRO and total BTEX levels in Sample MW6W2 constitute increases from the June, 1994 baseline levels for Monitoring Well MW06. In particular, the DRO concentration is observed to have increased by almost three times to its present value of 0.51 ppm. This increase may be attributable to the asphaltic product observed in the subsurface vicinity of remediation wells VES4, AIS7, and AIS8.

Similarly, the DRO, benzene, and total BTEX concentrations in Monitoring Well MW08 are shown in Graph 6 to have increased from the baseline readings. Since it is expected that operation of the remediation system will result in hydrocarbon decrease, this increase may be an anomaly and further sampling is necessary before any trends can be clearly identified. The non-detectable DRO and total BTEX concentrations in Samples MW3W2 and MW7W2 are shown in Graphs 2 and 5, respectively, to be consistent with the baseline values for each. The detection of DRO or BTEX constituents in the future will indicate that the defined limits of the hydrocarbon plume in the groundwater have increased from the current boundaries.

On-Going System Operation & Monitoring

Overall, the VES and AIS components of remediation system at this site are functoning in accordance with the corrective action plan. Hydrocarbon removal rates diminished quickly once the system was started for continous operation, as the VES is presently pulling less than 1.0 pound per day. The AIS is also running continuously, and caused a brief surge in hydrocarbon recovery immediately following startup. The third component of this site's remediation system consists of a bio-infiltration unit designed to enhance biodegradation by providing nutrients to the subsurface. Since the ground froze before this system could be started, use of the bio feed lines has been suspended until the spring of 1995.

Based on the hydrocarbon recovery rate observed in the first month of operation, it is our opinion that operation of the remediation system should be adjusted to run on a pulse schedule. During continous operation of the VES and AIS systems, preferential air flow pathways develop in the soils which serve to limit the effective treatment zone. Pulsed operation of the system should allow a greater hydrocarbon recovery rate during the active period, while conserving energy during the down time. A pulse schedule typically consists of alternating weeks of active and inactive periods, although the actual frequency at the site will be selected to maintain a sufficient oxygen supply in the subsurface at all times.

According to the requirements of the 1994 Corrective Action Workplan for this site, Shannon & Wilson will continue to monitor the operations and effectiveness of the remediation system. We will present the reports to ADEC following the predetermined schedule in the Workplan.

We appreciate this opportunity to be of service and your continued confidence in our firm. If you have any questions or comments concerning this submittal, please call the undersigned.

Sincerely,

SHANNON & WILSON, INC.

Prepared by:

Matthew Hemry
Engineer II

Reviewed by:

William S. Burgess
Principal Engineer

Approved by:

Fred R. Brown
Vice President

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REGISTERED PROFESSIONAL ENGINEER

Enc: Tables 1-4, Figures 1&2, Graphs 1-6, Appendix A

cc: Mr. Larry Frick
Mr. Mike Krueger

TABLE 1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
9/30/94														
	14:10	VES blower started for pilot test												
	14:15	VES1†	120		88	0.22	1900	166	54	17.0	41	4.8%		
	14:30	VES2†	2,000		88	0.2	1800	157	62	14.5	48	28.9%		
	14:45	VES3†	9,500		93	0.2	1810	158	58	15.0	43.5	55.7%		
	15:14	LINE1†	10,000		90	0.31	2275	199	38	12.5		45%		
	15:06	LINE2†	10,000		90	0.31	2275	199	39	11.0		70%		
	15:00	LINE3†	5,000		91	0.29	2200	192	41	11.0		50.3%		
	15:20	Opened valves to all VES lines except VES4 (due to product in the well)												
	15:25	Exhaust	4,500		87	0.37	2500	218	21	15.0		16%		
	15:30	VES Well VES1									5			
	15:30	VES Well VES2									7			
	15:30	VES Well VES3									8			
	15:30	Monitoring Well MW03									0			
	15:32	Monitoring Well MW06									0			
	15:34	Monitoring Well MW07									1			
	15:36	Monitoring Well MW08									0			
	16:20	VES Well VES1									9.5			
	16:20	VES Well VES2									5			
	16:20	VES Well VES3									9			
	16:20	Monitoring Well MW03									0			
	16:22	Monitoring Well MW06									0			
	16:24	Monitoring Well MW07									2			
	16:26	Monitoring Well MW08									1			
	16:30	Analytical Sample Y-5216-3-VES1 Collected												
	16:30	Exhaust Stack	4,500	340	80	0.38	2500	218	22	16		13.0%		29.80
	16:40	VES blower shut off												
10/14/94														
	9:50	VES blower started for continuous operation				0		0						
	9:50	Exhaust Stack	NM	NM	74	0.35	2350	205	31			18%	0%	
	10:20	Exhaust Stack	NM	NM	88	0.34	2375	207	31			10%	0%	

† - Measurement taken with valves closed to all other VES lines
NM - Not Measured
ppm - parts per million
fpm - feet per minute
scfm - standard cubic feet per minute

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TABLE 1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
	10:30	LINE3	1500		41	17-19*	50**	4		12.5		13.5%	0%	
	10:40	LINE2	65		40	21*	25**	2		20		2%	0%	
	10:50	LINE1	NM		49	20*	NM	NM		NM		NM	0%	
	10:55	VES1	15		50	19.5*	NM	NM		18.5		1%	0%	
	11:00	VES2	90		50	21*	NM	NM		19		1%	0%	
	11:03	VES3	600		50	20*	NM	NM		17.5		5%	0%	
	11:05	VES4	No flow/closed valve due asphaltic product in VES Well VES4											
	11:20	Analytical Sample Y-5216-3-VES2 collected												
	11:20	Exhaust Stack	600	115	87	0.32	2300	201	37	18		9%	0%	9.15
	11:45	Exhaust Stack	400	NM	86	0.32	2300	201	36.5	18		NM	0%	
	15:10	Exhaust Stack	650	NM	92	0.31	2275	199	36	19		8.5%	0%	
	15:20	LINE3	50											
	15:23	LINE2	120											
	15:25	LINE1	VES Line No. 1 was closed due to water in recovered vapor											
	15:27	VES1	180											
	15:29	VES2	130											
	15:32	VES3	500											
	15:35	VES4	Valve closed to VES Well VES4											
	15:50	Analytical Sample Y-5216-3-VES3 collected												
	15:50	Exhaust Stack	450	56.6	95	0.31	2300	201	38	19.5		7%	0%	4.44
10/15/94														
	15:35	Analytical Sample Y-5216-3-VES4 collected												
	15:35	Exhaust Stack	300	82.2	90	0.29	2200	192	38.5	20		6%	0%	6.22
10/17/94														
	15:10	Analytical Sample Y-5216-3-VES5 collected												
	15:10	Exhaust Stack	275	41.4	95	0.3	2233	195	39	20.5		5%	1%	3.15
10/18/94														
	19:00	Analytical Sample Y-5216-3-VES6 collected												
	19:00	Exhaust Stack	200	43.8	90	0.3	2225	194	40	20.5		5%	1%	3.35
10/19/94														
	17:25	Analytical Sample Y-5216-3-VES7 collected												
	17:25	Exhaust Stack	150	37.3	95	0.29	2200	192	40	20.5		5%	1%	2.80

* Negative pressure measurements conducted with pressure gauges (versus pressure differential measured with manometer)

** Measured directly with thermal anemometer (versus calculated from manometer readings)

TABLE 1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
10/28/94														
	A.M.	BC Excavating shut down VES to install manometers on individual VES lines/wells												
	15:20	LINE1	Valve closed to VES Line No. 1											
	15:22	LINE2				0	0	0						
	15:25	LINE3				0.235	1900	166						
	15:27	VES1				> 0.25	>1925	> 168						
	15:30	VES2				0.04	775	68						
	15:35	VES3				> 0.25	>1925	> 168						
	15:35	VES4	Valve closed to VES Well VES4											
	15:55	Analytical Sample Y-5216-3-VES8 collected												
	15:55	Exhaust Stack	110	7.5	82	0.3	2225	194	40.5	NM		10%	0%	0.58
10/31/94														
	15:15	LINE1	Valve closed to VES Line No. 1											
	15:15	LINE2				0	0	0						
	15:15	LINE3				0.02	550	48						
	15:15	VES1				> 0.25	>1925	> 168						
	15:15	VES2				0.04	775	68						
	15:15	VES3				> 0.25	>1925	> 168						
	15:15	VES4	Valve closed to VES Well VES4											
	15:35	Analytical Sample Y-5216-3-VES9 collected												
	15:35	Exhaust Stack	100	11	78	0.3	2225	194	41	NM		4%	0%	0.86
11/4/94														
	15:00	LINE1	Valve closed to VES Line No. 1											
	15:00	LINE2				0	0	0						
	15:00	LINE3				0	0	0						
	15:00	VES1				> 0.25	>1925	> 168						
	15:00	VES2				0.03	675	59						
	15:00	VES3				0.18	1650	144						
	15:00	VES4	Valve closed to VES Well VES4											
	15:05	Analytical Sample Y-5216-3-VES10 collected												
	15:05	Exhaust Stack	50	5.52	84	0.29	2175	190	41	NM		4%	0%	0.42
	15:10	AIS system started (See Table 2 for AIS performance log)												

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TABLE 1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
	16:30	LINE1	Valve closed to VES Line No. 1											
	16:30	LINE2				0	0	0						
	16:30	LINE3				0.15	1510	132						
	16:30	VES1				> 0.25	>1925	> 168						
	16:30	VES2				0.035	720	63						
	16:30	VES3				0.16	1555	136						
	16:30	VES4	Valve closed to VES Well VES4											
	16:40	Analytical Sample Y-5216-3-VES11 collected												
	16:40	Exhaust Stack	85	19.6	80	0.3	2225	194	41	NM		5%	0%	1.53
11/11/94														
	12:30	Exhaust Stack	30	NM	82	0.3		0	41	20.9		4%	0%	
	12:45	LINE1	Valve closed to VES Line No. 1											
	12:45	LINE2				0		0						
	12:45	LINE3				0.095		0						
	12:45	VES1				> 0.25		> 168						
	12:45	VES2				0.03		0						
	12:45	VES3				0.135		0						
	12:45	VES4	Valve closed to VES Well VES4											
	13:05	Analytical Sample Y-5216-3-VES12 collected												
	13:05	Exhaust Stack	50	8.22	84	0.29	2175	190	41	NM		4%	0%	0.62
11/16/94														
	12:00	Exhaust Stack	60	NM	81	0.3	2210	193	41	20.9		4%	0%	
	12:05	LINE1	Valve closed to VES Line No. 1											
	12:05	LINE2				0	0	0						
	12:05	LINE3				0	0	0						
	12:05	VES1				> 0.25	>2000	> 168						
	12:05	VES2				0.04	810	71						
	12:05	VES3				0.135	1490	130						
	12:05	VES4	Valve closed to VES Well VES4											
	12:10	Analytical Sample Y-5216-3-VES13 collected												
	12:10	Exhaust Stack	60	4.62	81	0.3	2210	193	41	20.9		4%	0%	0.36
	12:15	Opened valve to VES Line 1												
	12:17	Exhaust Stack	2000	NM	78	0.32	2290	200	36	20.9		11%	0%	

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TABLE 1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard) A	%LEL (Toxi-Guard) B	Vapor Discharge lbs/day
	12:25	LINE1				0.17	1670	146						
	12:25	LINE2				0	0	0						
	12:25	LINE3				0.18	1720	150						
	12:25	VES1				> 0.25	2000	> 168						
	12:25	VES2				0.02	570	50						
	12:25	VES3				0.105	1310	114						
	12:25	VES4	Valve closed to VES Well VES4											
	12:50	VES blower shut down during AIS and Monitoring Well testing												
	16:50	VES blower starated at completion of site monitoring activities												

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TABLE 2-AIR INJECTION SYSTEM (AIS) FIELD MEASUREMENTS

Date	Time	Measurement Location/Note	Temp F	Velocity fpm	Air Flow scfm	Well Head Pressure inches water	Blower Pressure inches water	DO ppm
10/4/94								
	11:00	Air Injection Blower started for pilot test						
		Balanced each AIS line:					98	
		AIS1		100		55*	98	
		AIS2		100		52*	98	
		AIS3		100		28*	98	
		AIS4		100		34*	98	
		AIS5		100		6*	98	
		AIS6		100		15*	98	
		AIS7		off		24*	98	
		AIS8		off		52*	98	
		AIS9		100		64*	98	
		AIS10		100		64*	98	
		AIS11		100		57*	98	
		AIS12		100		30*	98	
	14:00	AIS blower off						
10/6/94								
	14:00	Air Injection Blower started following recharge of AIS wells					103	
		AIS1		150			103	
		AIS2		100			103	
		AIS3		125			103	
		AIS4		110			103	
		AIS5		150			103	
		AIS6		125			103	
		AIS7		off			103	
		AIS8		off			103	
		AIS9		140			103	
		AIS10		50			103	
		AIS11		75			103	
		AIS12		75			103	
		X1		0			103	
		X2		0			103	
	14:05	Balanced each well to achieve uniform flow of 100 ft/min in each; blower pressure is 105 inches						
	14:30	Reduced blower pressure to 90 inches water; balanced wells to 100 ft/min air flow						
	15:15	AIS blower off						
11/4/94								
	15:10	Started AIS blower for continuous operation						
		Balanced AIS lines to 200 ft/min flow; blower pressure is 150 inches						
		AIS Well AIS11 requires the greatest pressure to achieve a given flow						

* Recorded values are the stabilized pressure observed once sparging had been achieved.

fpm - feet per minute

scfm - standard cubic feet per minute

ppm - parts per million

TABLE 2-AIR INJECTION SYSTEM (AIS) FIELD MEASUREMENTS

Date	Time	Measurement Location/Note	Temp F	Velocity fpm	Air Flow scfm	Well Head Pressure inches water	Blower Pressure psi	DO ppm
11/11/94								
	11:30	Balanced each AIS line:						
		AIS1	85	300-325			5.5	
		AIS2	85	300-325			5.5	
		AIS3	85	300-325			5.5	
		AIS4	85	300-325			5.5	
		AIS5	85	300-325			5.5	
		AIS6	85	300-325			5.5	
		AIS7		off				
		AIS8		off				
		AIS9	85	300-325			5.5	
		AIS10	85	300-325			5.5	
		AIS11	85	300-325			5.5	
		AIS12	85	300-325			5.5	
11/16/94								
		Wellhead pressure measurements taken at each AIS & monitoring well:						
	12:35	AIS1				62		
	12:37	AIS2				70		
	12:41	AIS3				44		
	12:43	AIS4				35		
	12:44	AIS5				14		
	12:45	AIS6				45		
	NM	AIS7				off		
	NM	AIS8				off		
	12:34	AIS9				66		
	12:27	AIS10				100+		
	12:23	AIS11				96		
	12:25	AIS12				49		
	12:49	MW03				0		
	12:47	MW06				0		
	12:46	MW07				0		
	12:47	MW08				0		
	12:50	Shut off AIS blower						
	14:45	AIS1						9.26
	14:53	AIS2						7.9
	14:57	AIS3						6.56
	15:01	AIS4						5.27
	15:05	AIS5						5.33
	NM	AIS6						NM
	NM	AIS7						NM
	15:10	AIS8						4.71
	14:38	AIS9						9.92
	15:17	AIS9						4.91
	15:22	AIS10						5.78
	15:25	AIS11						6.09
	15:30	AIS12						6.43

fpm - feet per minute
scfm - standard cubic feet per minute
ppm - parts per million

TABLE 3 - WATER SAMPLING LOG

BASELINE WATER LEVEL MEASUREMENT DATA (PRIOR TO START OF REMEDIATION SYSTEMS)

WELL NUMBER	AIS1	AIS2	AIS3	AIS4	AIS5	AIS6†	AIS7†	AIS8
DATE WATER LEVEL MEASURED	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94
TIME WATER LEVEL MEASURED	11:05	11:10	11:15	11:20	11:25	11:30	11:35	11:40
MP ELEVATION, FT *	50.20	50.18	50.07	50.13	49.88	49.67	49.41	49.42
DEPTH TO WATER BELOW MP, FT	15.82	16.14	17.27	17.64	17.36	NM	NM	16.40
WATER LEVEL ELEVATION, FT	34.38	34.04	32.80	32.49	32.52	NM	NM	33.02

WELL NUMBER	AIS9	AIS10†	AIS11†	AIS12†	MW03†	MW06†	MW07†	MW08†
DATE WATER LEVEL MEASURED	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94	9/30/94
TIME WATER LEVEL MEASURED	11:00	12:10	12:15	12:20	11:50	12:00	11:55	NM
MP ELEVATION, FT *	50.31	51.30	51.37	51.17	50.60	51.51	49.25	51.43
DEPTH TO WATER BELOW MP, FT	15.80	NM	NM	NM	NM	NM	NM	NM
WATER LEVEL ELEVATION, FT	34.51	NM	NM	NM	NM	NM	NM	NM

KEY

MP = Measuring Point
NM = Not Measured
* = MP Elevation Surveyed by RZA AGRA
† = Water Level Measurements unavailable for these wells due to a coating of viscous product from AIS Wells AIS6 & AIS7

000169

TABLE 3 - WATER SAMPLING LOG

WATER LEVEL MEASUREMENT DATA

WELL NUMBER	MW03	MW05	MW06	MW07	MW08			
DATE WATER LEVEL MEASURED	11/16/94	11/16/94	11/16/94	11/16/94	11/16/94			
TIME WATER LEVEL MEASURED	14:05	NM	14:20	14:14	14:00			
MP ELEVATION, FT *	50.60	NM	51.51	49.25	51.43			
DEPTH TO WATER BELOW MP, FT	6.73	NM	18.61	16.57	4.50			
WATER LEVEL ELEVATION, FT	43.87	NM	32.90	32.68	46.93			

SAMPLING/PURGING DATA

WELL NUMBER	MW03	MW05	MW06	MW07	MW08			
DATE SAMPLED	11/16/94	NS	11/16/94	11/16/94	11/16/94			
TIME SAMPLED	15:43	NS	16:07	15:56	16:20			
DEPTH TO WATER BELOW MP, FT	6.73	NM	18.61	16.57	4.50			
TOTAL DEPTH OF WELL BELOW MP, FT	22.20	13.70	24.00	21.10	12.30			
WATER COLUMN IN WELL, FT	15.47	NM	5.39	4.53	7.80			
GALLONS PER FOOT	0.16	0.16	0.16	0.16	0.16			
GALLONS IN WELL	2.48	NM	0.86	0.72	1.25			
TOTAL GALLONS PUMPED/BAILED	9.0	NS	3.0	3.0	3.0			
TEMPERATURE, C	7.5	NM	9.2	8.1	7.7			
SPECIFIC CONDUCTANCE, UMHOS/CM	500	NM	528	616	739			
pH	6.80	NM	6.31	6.64	6.15			
DISSOLVED OXYGEN, PPM	8.01	NM	4.52	11.03	5.49			
DIAMETER OF WELL CASING	2-inch	2-inch	2-inch	2-inch	2-inch			
REMARKS								

Purging & Sampling Method: Voss Disposable Bailer
Sampling Personnel: Matt Hemry & Melisa Collett

KEY

MP = Measuring Point
NM = Not Measured
NS = No Sample Taken
* = MP Elevation Surveyed by RZA AGRA

000170

TABLE 4 - SUMMARY OF VAPOR AND GROUNDWATER ANALYTICAL RESULTS

Vapor Samples

Parameter Tested	Method*	Analytical Sample Number (See Table 1 and Appendix A				
		VES1	VES2	VES3	VES4	VES5
Exhasut Stack FID Reading - ppm	Sensidyne FID	4500	600	450	300	275
Aromatic Volatile Organics (BTEX) - ppm	EPA 8020					
Benzene - ppm	EPA 8020	4.19	1.92	ND	ND	ND
Toluene - ppm	EPA 8020	1.51	0.68	0.335	0.463	0.248
Ethylbenzene - ppm	EPA 8020	1.19	0.075	1.21	0.686	ND
Xylenes - ppm	EPA 8020	3.24	0.497	3.161	1.748	ND
Total BTEX - ppm	EPA 8020	10.13	3.172	4.706	2.897	0.248
Volatile Petroleum Hydrocarbons (VPH) - ppm	EPA 5030/8015M	340	115	56.6	82.2	41.4
Volatile Petroleum Hydrocarbons - lbs/day	Ideal Gas Law**	29.8	9.15	4.44	6.22	3.15

Parameter Tested	Method*	Analytical Sample Number (See Table 1 and Appendix A				
		VES6	VES7	VES8	VES9	VES10
Exhasut Stack FID Reading - ppm	Sensidyne FID	200	150	110	100	50
Aromatic Volatile Organics (BTEX) - ppm	EPA 8020					
Benzene - ppm	EPA 8020	ND	ND	ND	ND	ND
Toluene - ppm	EPA 8020	0.223	0.231	ND	ND	ND
Ethylbenzene - ppm	EPA 8020	0.452	0.29	ND	0.057	ND
Xylenes - ppm	EPA 8020	1.773	1.131	0.097	0.078	ND
Total BTEX - ppm	EPA 8020	2.448	1.652	0.097	0.135	ND
Volatile Petroleum Hydrocarbons (VPH) - ppm	EPA 5030/8015M	43.8	37.3	7.5	11.0	5.5
Volatile Petroleum Hydrocarbons - lbs/day	Ideal Gas Law**	3.35	2.8	0.58	0.86	0.42

Parameter Tested	Method*	Analytical Sample Number (See Table 1 and Appendix A				
		VES11	VES12	VES13		
Exhasut Stack FID Reading - ppm	Sensidyne FID	85	50	85		
Aromatic Volatile Organics (BTEX) - ppm	EPA 8020					
Benzene - ppm	EPA 8020	ND	0.074	ND		
Toluene - ppm	EPA 8020	ND	0.171	0.072		
Ethylbenzene - ppm	EPA 8020	ND	ND	ND		
Xylenes - ppm	EPA 8020	ND	ND	0.146		
Total BTEX - ppm	EPA 8020	ND	0.245	0.218		
Volatile Petroleum Hydrocarbons (VPH) - ppm	EPA 5030/8015M	19.6	8.2	4.6		
Volatile Petroleum Hydrocarbons - lbs/day	Ideal Gas Law**	1.53	0.62	0.36		

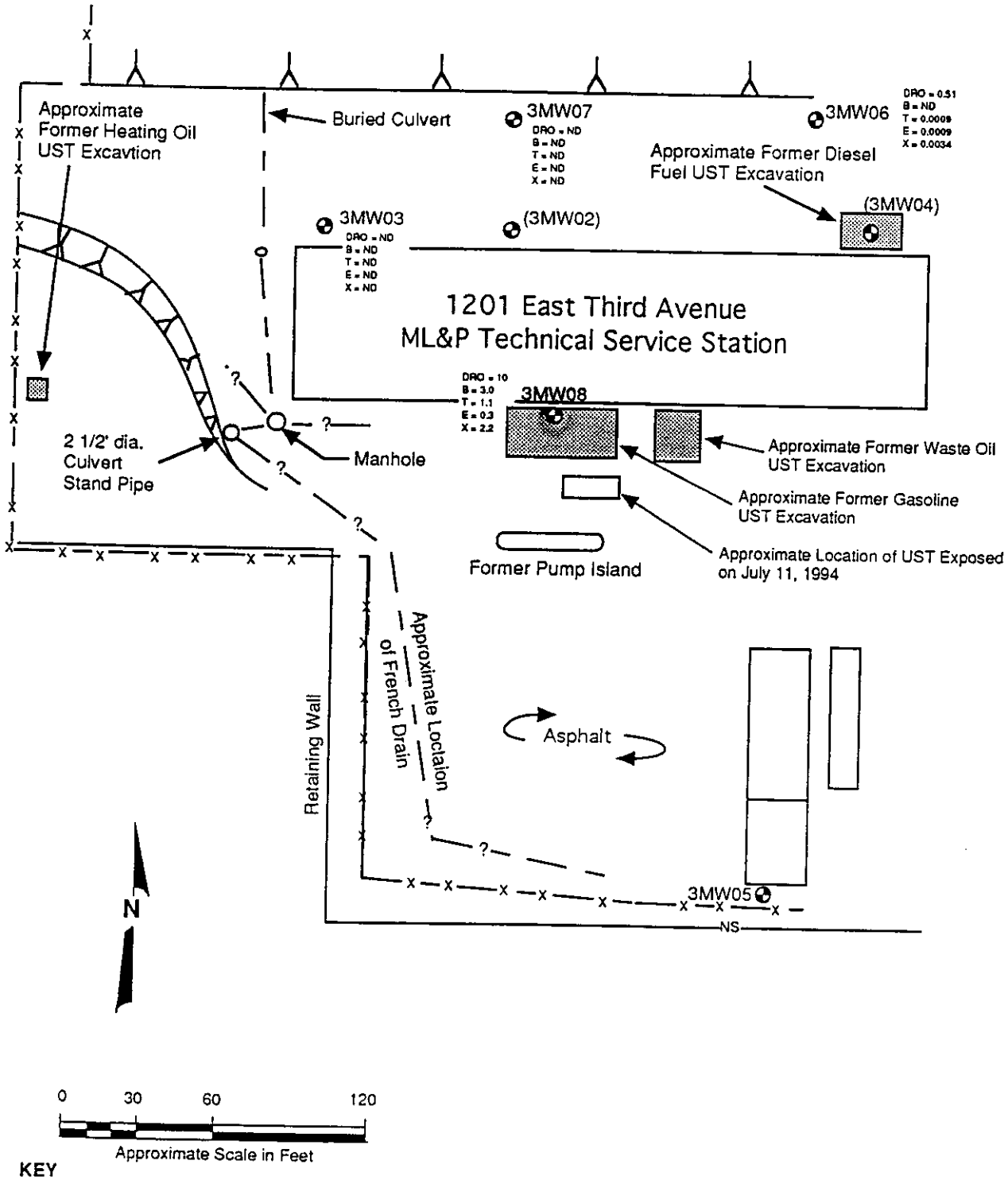
KEY	DESCRIPTION
ND	NOT DETECTED
*	SEE APPENDIX A FOR DETECTION LIMITS
**	USING A GAS CONSTANT OF R=75.6 Pa•m^3/Kg•K

TABLE 4 - SUMMARY OF VAPOR AND GROUNDWATER ANALYTICAL RESULTS

Water Samples

		Analytical Sample Number (See Table 1 and Appendix A				
Parameter Tested	**Method***	MW3W2	MW5W2	MW6W2	MW7W2	MW8W2
Diesel Range Organics (DRO) - ppm	EPA 3550/8100M	ND	--	0.51	ND	10
Aromatic Volatile Organics (BTEX) - ppm	EPA 602					
Benzene - ppm	EPA 602	ND	--	ND	ND	3.00
Toluene - ppm	EPA 602	ND	--	0.0009	ND	1.10
Ethylbenzene - ppm	EPA 602	ND	--	0.0009	ND	0.30
Xylenes - ppm	EPA 602	ND	--	0.0034	ND	2.20
Total BTEX - ppm	EPA 602	ND		0.0052	0	6.60

KEY	DESCRIPTION
ND	NOT DETECTED
--	NOT MEASURED FOR THIS PARAMETER
*	SEE APPENDIX A FOR DETECTION LIMITS



0 30 60 120

Approximate Scale in Feet

KEY

3MW04 — Number and approximate location of monitoring wells installed by Harding Lawson associates

(3MW04) — Number and approximate location of monitoring wells destroyed during utility excavation activities, September, 1993

3MW04 — Number and approximate location of monitoring wells installed by Shannon & Wilson, May, 1994

DRO = ND, B = ND, T = ND, E = ND, X = ND — DRO, & BTEX concentrations in ppm, November 28, 1994 groundwater monitoring round

NS — Not sampled during the most recent groundwater monitoring round

Site plan derived from Harding Lawson Associates, May 1993

1201 East Third Avenue
Anchorage, Alaska

SITE PLAN

December, 1994 Y-5216-3

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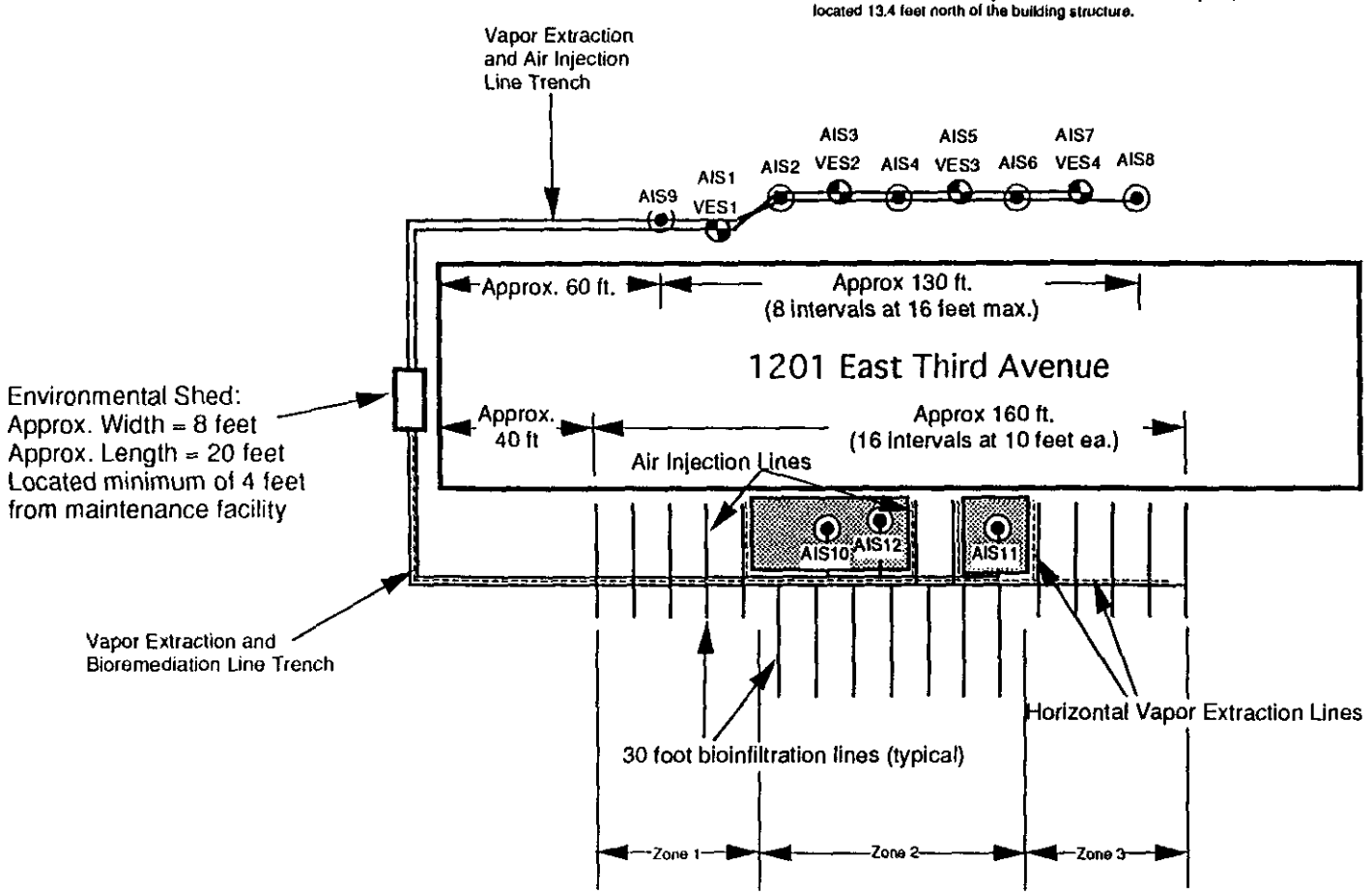
Geotechnical & Environmental Consultants

FIG. 1

NOTE: AIS wells AIS2 through AIS8 and VES wells VES2 through VES4 are located within 1.5 feet of an east-west axis located 17.0 feet north of the technical service facility. VES Well VES 4 is an exception, and is located 13.4 feet north of the building structure.



KEY

AIS1 / VES1 — Co-located Vapor Extraction Well VES1 & Air Injection Well AIS1

AIS9 — Air Injection Well AIS9

Approximate Former Location of Gasoline and Waste Oil UST Excavations

0 25 50 100

Approximate Scale in Feet

N

1201 East Third Avenue
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REMEDIATION LINE DETAIL

December, 1994

Y-5216-3

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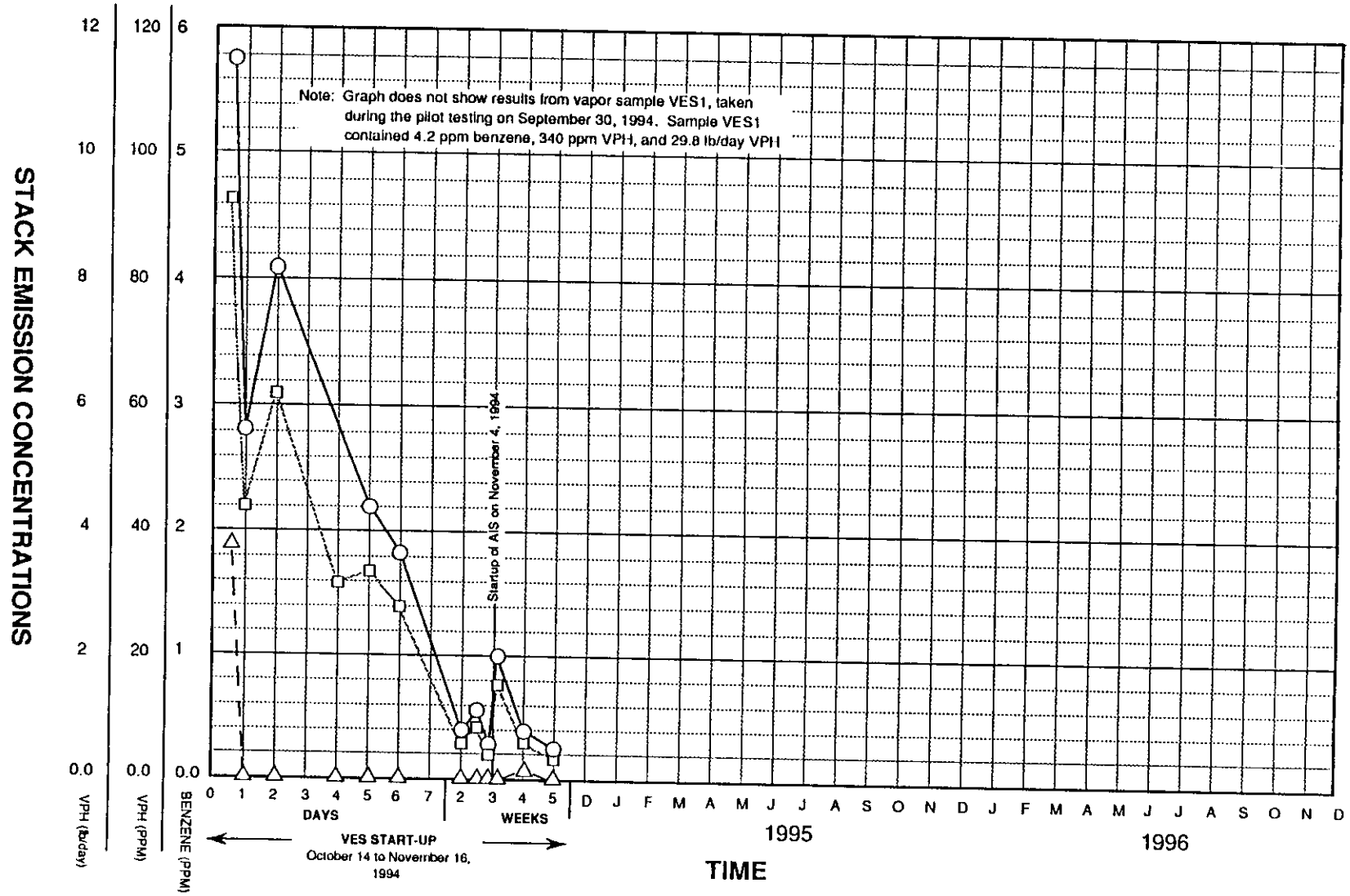
Fig. 2



LEGEND

- □ Exhaust Stack Vapor - VPH (lb/day)
- ○ Exhaust Stack Vapor - VPH (PPM)
- △ Exhaust Stack Vapor - Benzene (PPM)
- ★ Benzene at Air Monitoring Station No. 1
- ▲ Benzene at Air Monitoring Station No. 2
- ● Benzene at Air Monitoring Station No. 3
- ■ Benzene at Air Monitoring Station No. 4

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Anchorage, Alaska

VAPOR CONCENTRATION VS. TIME TRENDS

December, 1994 | Y-5216-3

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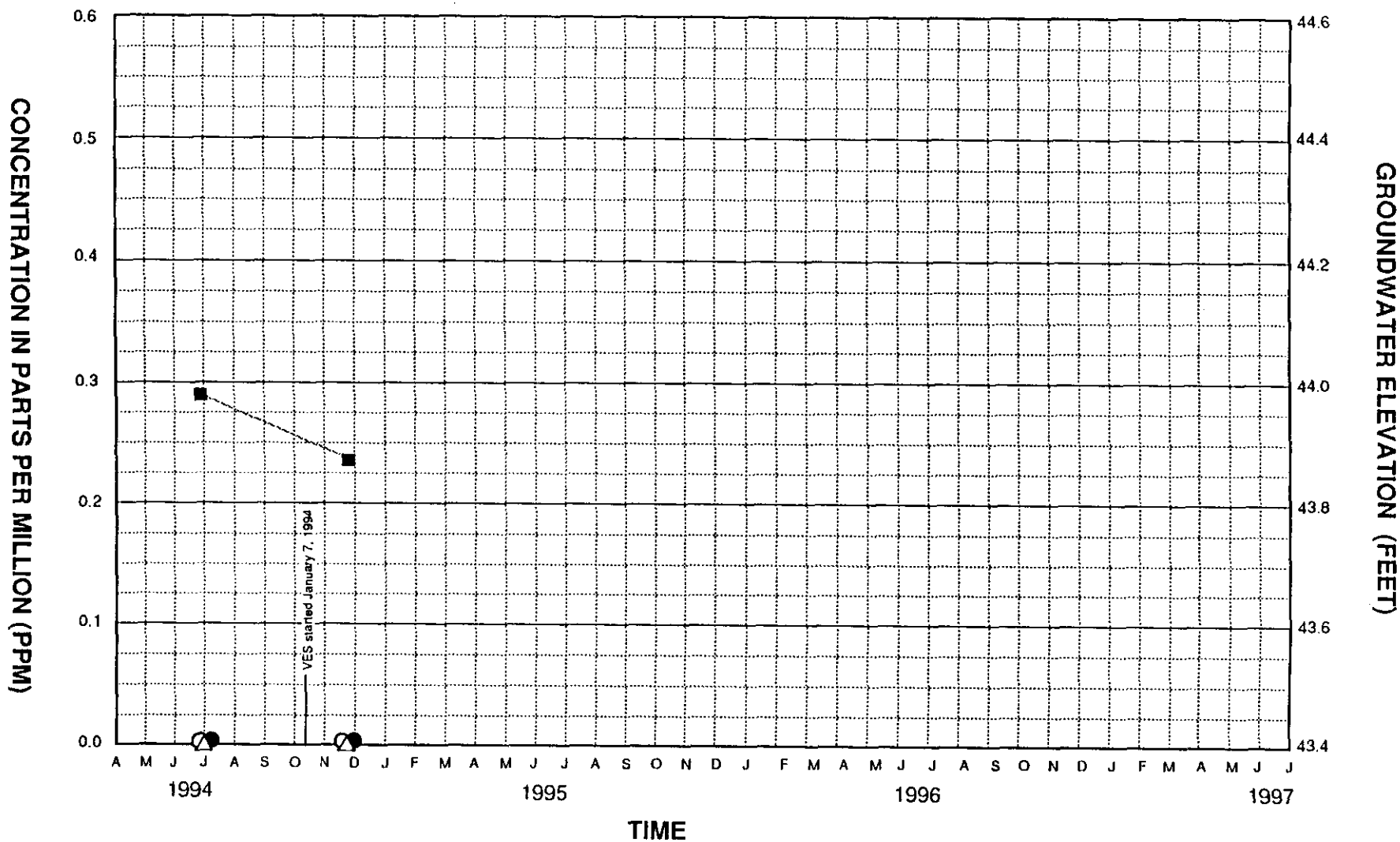
Graph 1

00015



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW03 TRENDS

December, 1994 Y-5216-3

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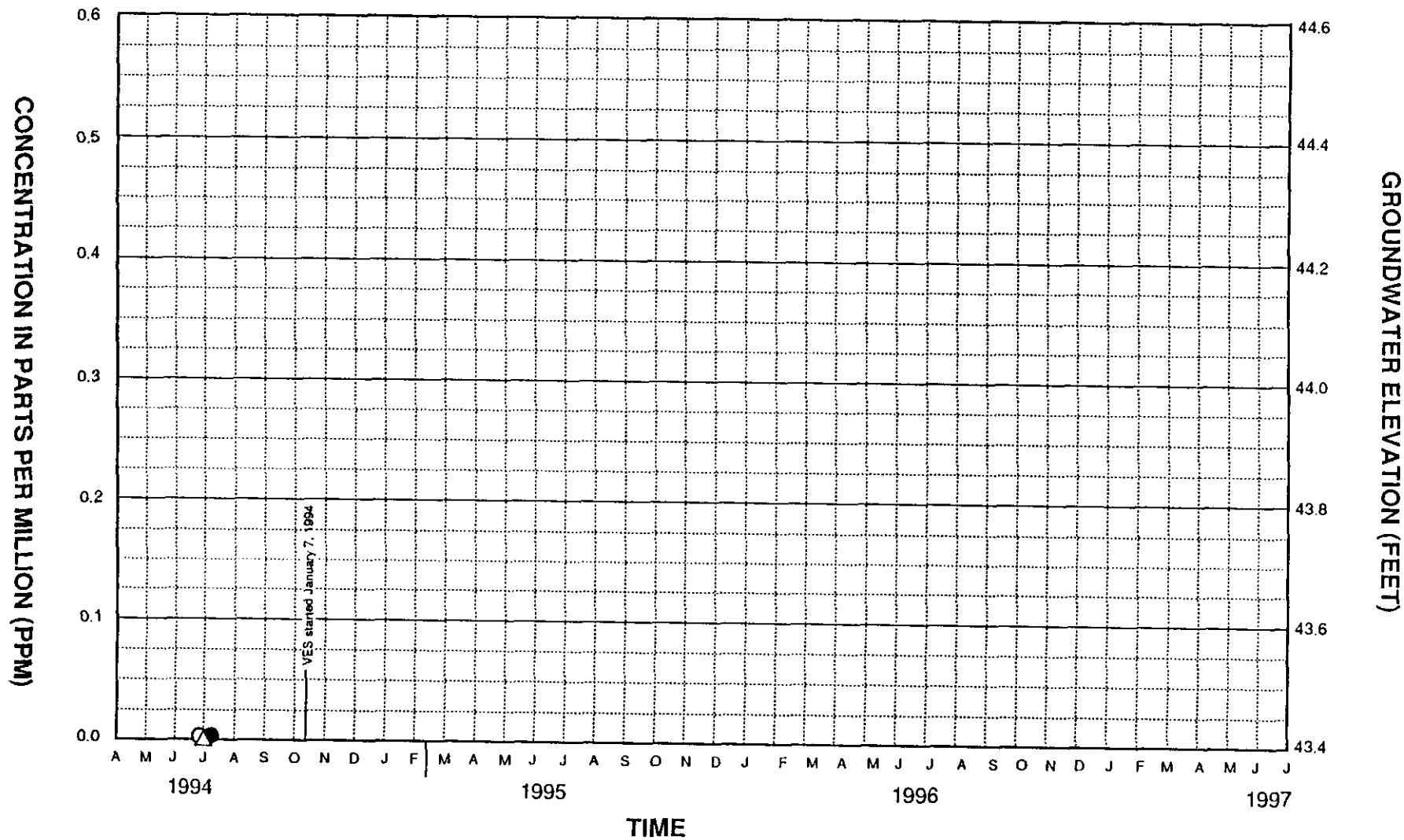
Graph 2

000476



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW05 TRENDS

December, 1994 Y-5216-3

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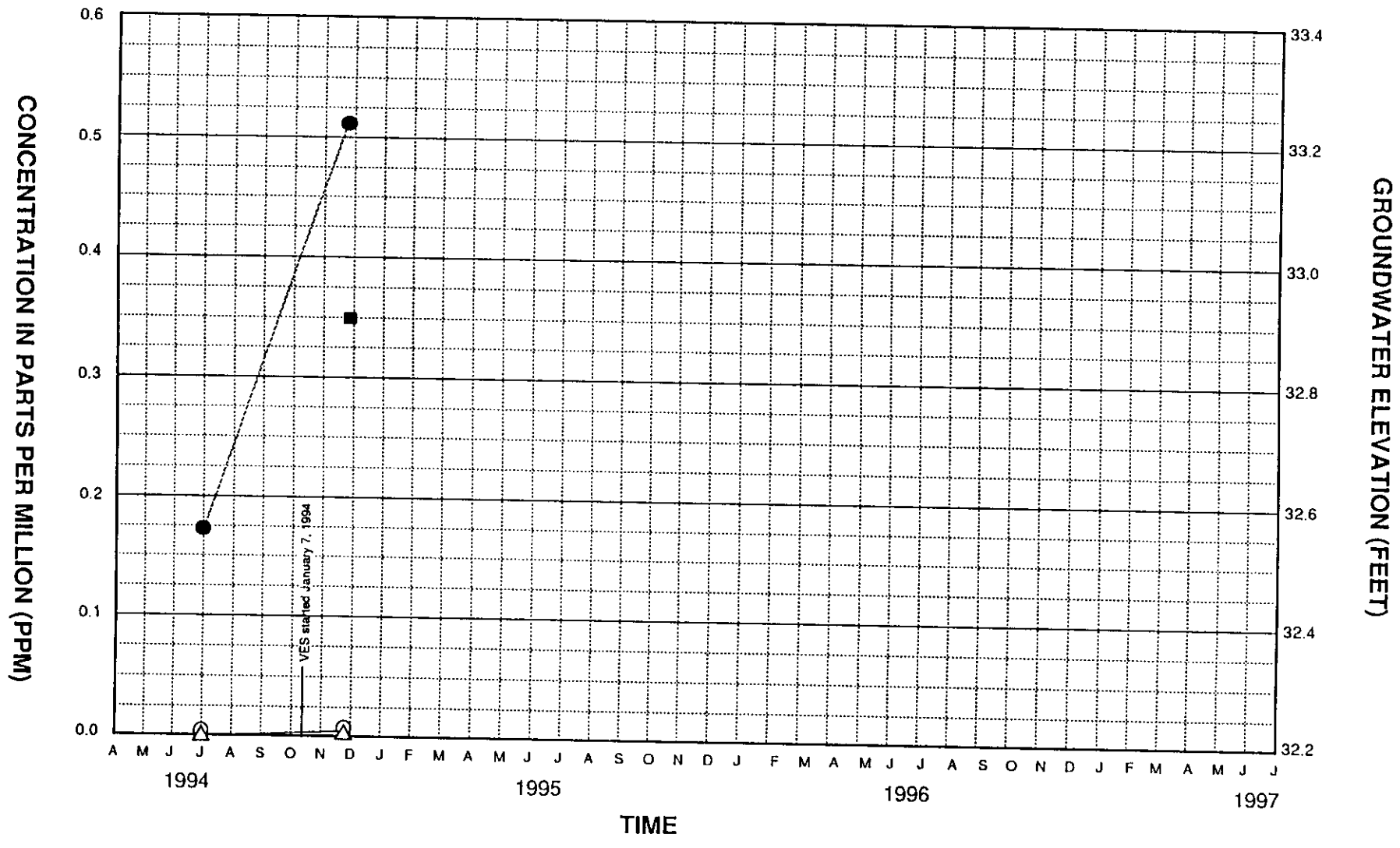
Graph 3

001177



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW06 TRENDS

December, 1994 Y-5216-3

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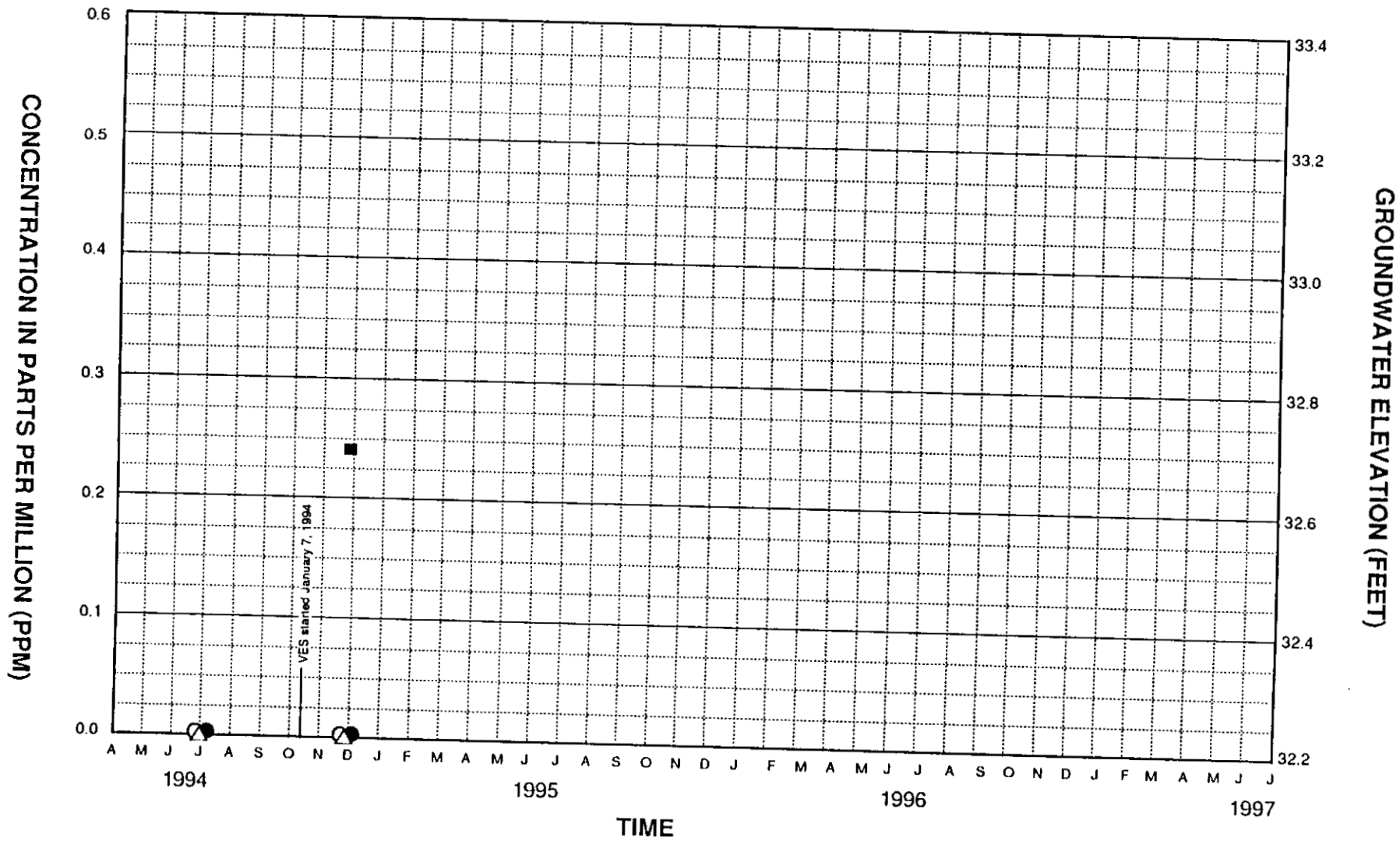
Graph 4

000178



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

1201 East Third Avenue
Anchorage, Alaska

MONITORING WELL MW07 TRENDS

December, 1994 Y-5216-3

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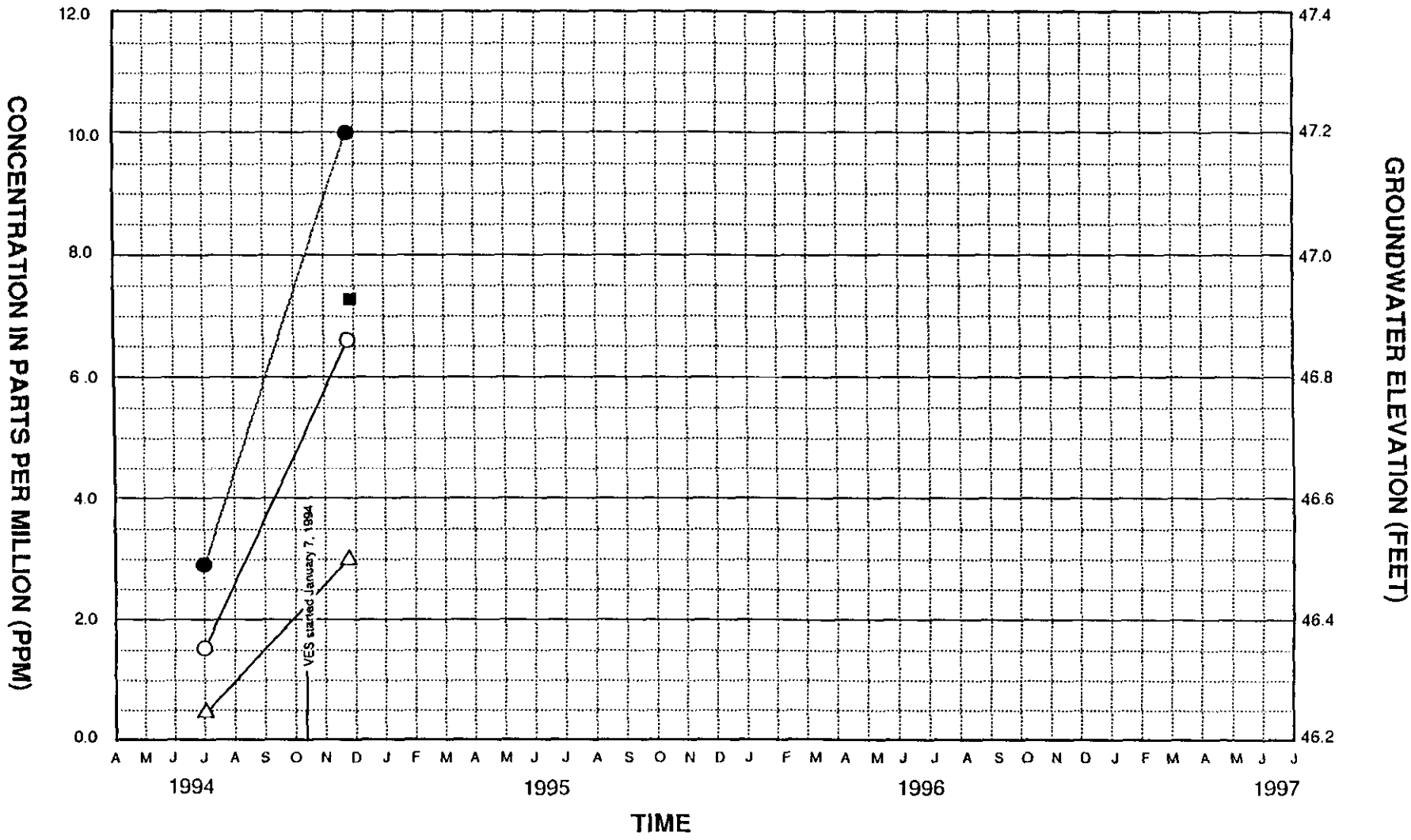
Graph 5



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

1201 East Third Avenue
Anchorage, Alaska

MONITORING WELL MW08 TRENDS

December, 1994 Y-5216-3

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Graph 6

000180

000181 L6907

Municipality of Anchorage
Rick Mystrom, Mayor

Municipal Light & Power
1200 East First Avenue
Anchorage, Alaska 99501-1685
Telephone: (907) 279-7671, Telecopiers: (907) 263-5804, 277-9272

July 10, 1995

RECEIVED
JUL 12 1995
DEPARTMENT OF
ENVIRONMENTAL CONSERV
ADO

Ms. Eileen Olson
ADEC/ADO
555 Cordova
Anchorage, AK 99501

Dear Eileen:

Enclosed is a report from Shannon & Wilson, Inc. summarizing activities at our 1201 E. Third Avenue site for the period December 1994 through May 1995. If you have any questions concerning this information, please call me at 263-5273.

Sincerely,

James A. Pfeiffer
Environmental Engineer

Enclosure

Putting Energy into Anchorage for Over 60 years

000182 L69.07

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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JUL 12 1995

DEPARTMENT OF
ENVIRONMENTAL CONSERV
ADO

June 27, 1995

Municipal Light & Power
1201 East Third Avenue
Anchorage, Alaska 99501

Attn: Mr. Jim Pfeiffer

RE: DECEMBER 1994 THROUGH MAY 1995 REMEDIATION MONITORING AT MUNICIPAL LIGHT AND POWER SITE NO. 3, 1201 E. THIRD AVENUE, ANCHORAGE, ALASKA

This letter report summarizes the status of the vapor extraction and air injection remediation system at Municipal Light and Power (ML&P) Site No. 3, 1201 E. Third Avenue, Anchorage, Alaska. Included in this report are a record of field activities conducted at the site, an operation log of the combined vapor extraction/air injection remediation system (VEAIS), and results of quarterly groundwater monitoring. A site plan illustrating the general features at the project location is provided in Figure 1.

Soil Vapor Extraction System (VES) Monitoring

The Vapor Extraction System (VES) located at this site consists of three subsurface horizontal vapor recovery lines, designated VES Lines 1 through 3, and four vertical vapor extraction wells, designated VES Wells 1 through 4. As shown in Figure 2, VES Lines 1 through 3 are located to the south of the maintenance facility, with the slotted section of each of the three pipes extending to one of three treatment zones. The primary function of the horizontal VES lines is to remove petroleum hydrocarbons remaining in the vadose zone surrounding the former gasoline and waste oil underground storage tank (UST) excavations. A secondary purpose of these VES pipes is to vent hydrocarbons volatilized from the groundwater by the AIS. In comparison, the vertical VES wells serve primarily to vent the air injected into nine vertical AIS wells. Although impacted soils were not originally anticipated in the vadose zone to the north of the maintenance facility, the fence of AIS wells was placed in order to intercept impacted groundwater which may be migrating underneath the building. VES Wells 1 through 4, which are spaced approximately 30 feet apart along an east-west axis, provide a vent for the air injected into AIS Wells AIS1 through 9. In addition to the seven VES lines which presently comprise the remediation system, an extra VES line was installed in the subsurface soils to the north of the service facility. This line does not contain a slotted pipe section, and was placed to accommodate potential system expansion.

The VES component of the remediation system has been operating on a continuous basis since October 14, 1994. Six of the seven VES lines have been actively removing vapors from the subsurface. The exception is Well VES4, which has not been opened due to concerns that the asphaltic product observed in this well would be pulled through the pipe and damage the blower. Monitoring of the VES included monthly collection of vapor analytical samples from the sampling port installed on the exhaust manifold. Prior to sampling, field measurements were conducted to verify that the vapor sample would be representative of the stack exhaust. Approximately every 5 minutes, temperature and flame ionization detector (FID) readings of the stack emissions were

Y-5216-3

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ANCHORAGE, ALASKA 99518
907 • 561 • 2120 FAX 907 • 561 • 4483

recorded. In addition, the velocity of air movement in the stack exhaust and the individual VES lines was measured in inches of water using pitot tubes. Once these parameters stabilized, analytical samples were collected in 1 liter stainless steel cylinders provided by the laboratory.

During the December 1994 to May 1995 sampling period, a total of six vapor samples were collected from the VES exhaust. Sample VES14 was taken on December 26, 1994, and Samples VES16, VES17, VES18, VES19, and VES20 were obtained on January 19, February 27, March 30, May 1, and May 31, 1995, respectively. Sample VES15 does not exist and was skipped due to an error in labelling.

In addition to exhaust vapor sampling, system monitoring included measuring performance parameters of the individual VES lines. On the date of each sampling event, the differential pressure in each line was measured using a pitot tube. These values would subsequently be used to calculate the air flow rate in each individual VES line. Furthermore, FID readings in each line were also measured during the February 27 and May 31, 1995, sampling events. A log of system performance, including dates of sample collection and field monitoring data, is provided in Appendix A.

Air Injection System (AIS) Monitoring

The AIS located at this site presently consists of twelve active air injection wells. As shown in Figure 2, AIS Wells AIS1 through AIS9 are located to the north of the technical service facility. These nine wells are spaced approximately 16 feet apart along the same axis as the VES wells and are positioned to intercept impacted groundwater which may migrate underneath the building from the former UST locations. The remaining three active wells, AIS10 through AIS12, are located to the south of the service facility in the former UST excavation areas. These three wells are intended to actively remediate the petroleum hydrocarbons remaining in the vicinity of the former USTs. Two additional inactive AIS lines were installed in the subsurface soils to the north of the service facility to accommodate potential system expansion. Each AIS well serves to treat groundwater using the combined effects of volatilization and enhanced biodegradation. By inducing a positive air flow into the saturated soil zone, the AIS functions as an in-situ air stripper which transports volatile hydrocarbon constituents into the vadose zone where they are extracted by the VES pipes. In addition, the air flow replenishes the subsurface oxygen supply, thereby increasing the capacity for aerobic degradation of the petroleum hydrocarbons. In order to avoid directing hydrocarbon-laden vapors into the service facility through the AIS-induced subsurface air flow, the remediation system is wired such that the AIS will only operate in conjunction with the VES.

The AIS system began continuous operation on November 4, 1994. Presently, ten of the twelve AIS lines are active. The lines connected to wells AIS7 and AIS8 remain closed since the closest VES well, VES4, cannot be operated due to the presence of asphaltic product in the well. In comparison with the VES, the AIS' contribution to subsurface remediation can not be measured using field screening methods. Instead, monitoring of the AIS is directed at maintaining a subsurface air flow. To accomplish this, the pressure to each individual AIS well is balanced on a regular basis to achieve a uniform air flow, and pressures are recorded at each wellhead. Following a temporary system shutdown to allow water to recharge the wells, dissolved oxygen

readings are obtained to verify the infiltration of air into the saturated soils surrounding each well. A log of AIS system performance and field measurements is provided in Appendix A.

On November 11, 1994, each of the ten active AIS wells was balanced to provide a flow rate of 300 to 325 feet per minute (fpm) at a blower pressure of 5.5 pounds per square inch (psi). As listed in Table 2, however, flow rates varied between 60 fpm and 200 fpm at a blower pressure of 4.4 psi when measured on May 31, 1995. To balance the system, each well was adjusted to a uniform flow rate of 200 fpm at a blower pressure of 5.1 psi. At this blower pressure, the corresponding wellhead pressures measured for the individual AIS wells ranged from 26 inches of water (0.9 psi) in Well AIS5 to over 100 inches of water (3.6 psi) in Well AIS2. Subsequently, the AIS blower was shut off and the individual AIS wells were allowed to recharge with groundwater. Approximately 1 hour later, groundwater samples were collected from each AIS well to measure dissolved oxygen levels. Concentrations ranged from 3.84 ppm in Well AIS4 to 6.85 ppm in Well AIS10. Since oxygen is generally believed to become a limiting factor to biodegradation processes only at concentrations less than 3 ppm, the AIS appears to be sufficiently replenishing the dissolved oxygen in the groundwater. A complete list of dissolved oxygen measurements is provided in the water sampling log included in Appendix A.

Ambient Air Quality Monitoring

Air quality monitoring at this site is conducted as necessary to confirm that the OSHA /ACGIH (Occupational Safety & Health Administration and the American Conference of Government Industrial Hygienists) ambient benzene standards of 1.0 ppm for a time-weighted average (TWA) exposure is not exceeded. Since each of the six vapor samples collected from the VES exhaust stack contained non-detectable benzene concentrations, no air quality monitoring was conducted during the present sampling period. Furthermore, computer modelling of the site using the EPA dispersion modelling program "Screen2" indicated that a minimum total benzene emission of 1700 ppm from within the exhaust stack was required to raise the maximum ambient plume concentration to 1.0 ppm anywhere within 500 meters radius of the environmental shed.

Groundwater Monitoring

Groundwater monitoring at this site consists of quarterly sampling conducted to evaluate the hydrocarbon concentrations remaining in the site's groundwater and to gauge the progress of the remediation efforts. Presently, five (5) monitoring wells are included in the monitoring program. The location of Monitoring Wells MW03, MW05, MW06, MW07, and MW08 are plotted on Figure 1.

Two groundwater sampling events were conducted during the December 1994 to May 1995 sampling period. Groundwater samples were collected from each of Monitoring Wells MW03, MW06, and MW08 on January 19, 1995, and from Monitoring Wells MW03, MW06, MW07, and MW08 on May 31, 1995. Monitoring Well MW05, which serves as a background well, has been temporarily removed from the sampling program at this site. Since Monitoring Wells MW03 and MW07 presently do not contain detectable petroleum hydrocarbons, there is not an outstanding need for additional background data. Temperature, specific conductance, pH, and dissolved oxygen values of the water samples were measured in the field at the time of sampling. The data for the purging, water level, pH, conductivity, temperature, and dissolved oxygen measurements

for the January and May sampling events are presented in Appendix A. It is evident in Figures 1 and 2 that the measured groundwater elevations in the monitoring wells and AIS wells indicate the direction of groundwater flow is generally to the north to northeast.

Although the direction of groundwater flow was similar over the four sampling events conducted at this site, the magnitude of the groundwater elevations did vary. Between the November 16, 1994 and January 19, 1995 sampling events, the groundwater elevations in Monitoring Wells MW03, MW06, and MW08 fell between 0.04 and 2.95 feet. As shown in Graphs 2, 4, and 6, respectively, the elevations measured in January 1995 constitute the lowest values recorded over the past year of sampling. Conversely, the groundwater elevations rose between the January and May 1995 sampling events, with increases ranging from 1.12 feet in Monitoring Well MW06 to 3.06 in Monitoring Well MW03. The average change in groundwater elevations in Monitoring Wells MW03 and MW06, which do not fall within the remediation system's radius of influence, is shown in Graph 1.

Laboratory Analyses

For the period of December 1994 through May 1995, a total of six (6) vapor samples from the VES discharge stack were collected using stainless steel vapor canisters. All samples were submitted to Commercial Testing & Engineering (CT&E) of Anchorage under Chain-of-Custody procedures and were analyzed for aromatic volatile organics (BTEX) using EPA Method 8020 and volatile petroleum hydrocarbons (VPH) using EPA Method 5030/8015. The results for all vapor canister analyses are listed in Table 1 with the individual laboratory reports included in Appendix B. A historical summary of hydrocarbon concentrations in the VES stack exhaust is presented in Graph 1.

The three (3) groundwater samples collected during the January 19, 1995 groundwater sampling event and the four (4) groundwater samples obtained during the May 31, 1995 event were submitted to Superior Precision Analytical Laboratories, Inc., using Chain-of-Custody procedures. Each sample was analyzed for BTEX using EPA Method 602 and diesel range organic compounds (DRO) using EPA Method 3550/8100M. The results for all groundwater analyses are listed in Table 1, with historical summaries of petroleum hydrocarbon concentrations presented for each monitoring well in Graphs 2 through 6. All laboratory reports are included in Appendix B.

Discussion Of Results

Soil Vapor - As shown in Graph 1, the petroleum hydrocarbon concentrations in the stack exhaust decreased steadily in the first three weeks following startup of the VES on October 14, 1994. A slight increase in concentrations was observed to correspond with the startup of the AIS on November 4, 1994. With the combined vapor extraction/air injection system (VEAIS) running on a continuous basis, recovered hydrocarbon vapors decreased in concentration over the subsequent four sampling events. Concentrations were at their lowest levels in December 1994, as Sample VES14 contained non-detectable benzene, 0.548 ppm total BTEX, and 1.07 ppm, or 0.09 lb/day, VPH. Between December 1994 and May 1995, vapor samples were collected monthly, with the measured hydrocarbon concentrations comprising an erratic pattern. Vapor concentrations increased in Samples VES16 and VES17, collected on January 19 and February 27, 1995,

respectively. The 13.4 ppm, or 1.06 lb/day, VPH contained in Sample VES17 was the highest vapor concentration measured since immediately following the startup of the AIS in November 1994. Hydrocarbon levels in Samples VES18, VES19, and VES20, collected on March 30, May 1, and May 31, 1995, respectively, were inconsistent. The most recent sample, Sample VES20, contained non-detectable benzene, 0.413 ppm total BTEX, and 5.27 ppm, or 0.36 lb/day, VPH.

The varying hydrocarbon recovery measured in the VES exhaust may be attributable to fluctuating groundwater elevations. Between the June and November 1994 sampling events, the average groundwater at the site rose by about 1 foot. As shown in Graph 1, VES hydrocarbon vapor recovery generally decreased over this period as the vadose zone became shallower with the rising water table. Sometime following the November 1994 sampling event, groundwater elevations began to fall, with a average drop of approximately 1.5 feet observed between the November 1994 and January 1995 sampling events. Correspondingly, the vapor recovery increased between December 1994 and March 1995 as the water table receded to expose additional soil to the VES-induced airflow. The trends reversed once more after the relative peak value measured in March 1995, with generally decreasing vapor concentrations measured between March and June 1995. The groundwater is shown to have increased by more than 2 feet between these two sampling events.

Using the Ideal Gas Law, VPH analytical results, and the calculated daily rate of air flow from the VES, the average daily rate of volatile petroleum hydrocarbon discharge for the operating period from December 1994 through May 1995 was computed to be about 0.5 pounds per day. Approximately 85 pounds of volatile petroleum hydrocarbons were vented from the site's subsurface soil during this period of VES operation.

Groundwater - During both the January and May 1995 sampling events, detectable BTEX and/or DRO constituents were measured in only the groundwater samples collected from Monitoring Wells MW06 and MW08. The highest concentrations were measured in Monitoring Well MW08, which is positioned within the area of the former gasoline and waste oil UST excavations. Sample MW8W3, collected on January 19, 1995, contained 4.10 ppm DRO, 1.60 ppm benzene, and 7.95 ppm total BTEX. Lower concentrations were measured in the groundwater sample taken from this well on May 31, 1995, as Sample MW8W4 had 1.40 ppm DRO, 0.07 ppm benzene, and 0.31 ppm total BTEX. As shown in Graph 6, these results are consistent with the generally decreasing trend for hydrocarbon constituents established following startup of the VEAIS. The present concentrations are the lowest of the four samples obtained from this well since November 1994, and constitute decreases of 86% to 98% from the peak values measured in November 1994 and January 1995.

In contrast, the hydrocarbon concentrations measured in the groundwater samples collected from Monitoring Well MW06 appear to be increasing. Sample MW6W3, collected on January 19, 1995, contained 0.970 ppm DRO, non-detectable benzene, and 0.0034 ppm total BTEX. These results are shown in Graph 4 to be consistent with the previous sampling event for BTEX constituents, but continue an increasing trend in DRO. The results of the May 31, 1995, sampling event exhibit a conflicting pattern, however, as the DRO concentration levelled off and the BTEX concentrations increased. Sample MW6W4 contained 0.920 ppm DRO, 0.017 ppm benzene, and 0.0663 ppm total BTEX.

The cause of the increasing benzene and total BTEX concentrations in Monitoring Well MW06 is not known, although there are several potential explanations. First, the presence of high BTEX concentrations may signify an expansion of the plume boundary originating from the former UST excavation to the south of the facility. A second potential cause is the high water table, which may have risen into a "smear zone" of soils impacted with BTEX. This explanation appears to be inconsistent with the data for Monitoring Well MW08, in which the rising groundwater elevation is accompanied by lower hydrocarbon concentrations. Since Monitoring Well MW08 is positioned within the hydrocarbon source area, however, the primary determination of hydrocarbon concentrations is likely to be the effectiveness of the remediation system operating in these soils rather than the effects of a fluctuating water table. Furthermore, the effects of a variable groundwater elevation are expected to be less here than in other areas, since the top four feet below grade in the former UST excavations consists of clean, imported fill material. The third potential cause of increasing hydrocarbon concentrations is the asphaltic product observed in remediation wells VES4, AIS7, and AIS8. An asphaltic product, while relatively slow to migrate in the subsurface, would likely lead to elevated DRO and BTEX concentrations in the groundwater it contacted. This theory is supported by the detection of similar patterns of DRO, BTEX, and poly-nuclear aromatic compounds (PNAs) in the asphaltic product and groundwater samples collected from Monitoring Well MW06. A more detailed discussion of this issue is presented under separate cover in Shannon & Wilson's January 1995 letter "Unknown Product Characterization and Source Identification, ML&P Site No. 3, 1201 East Third Avenue, Anchorage, Alaska."

Groundwater samples were also obtained from Monitoring Well MW03 during both the January and May 1995 sampling events, and from Monitoring Well MW07 during the May 1995 sampling round. Samples MW3W3, MW3W4, and MW7W4 each contained non-detectable DRO, benzene, and total BTEX. It is evident in Graphs 2 and 5 that no hydrocarbons have been detected in Monitoring Wells MW03 and MW07 since monitoring was initiated in June 1994.

On-Going System Operation & Monitoring

Overall, the VES and AIS components of remediation system at this site are functioning in accordance with the corrective action plan. Hydrocarbon removal rates diminished quickly once the system was started for continuous operation, as the VES is presently pulling an estimated 0.5 pounds per day. The AIS is also running continuously, and caused a brief surge in hydrocarbon recovery immediately following startup. The third component of this site's remediation system consists of a bio-infiltration unit designed to enhance biodegradation by providing nutrients to the subsurface. We anticipate that the first nutrient application will be pumped within the next quarterly sampling period.

Due to the relatively low hydrocarbon recovery rate measured during the December 1994 to May 1995 sampling period, increases in removal efficiency may be gained through operation of the remediation system on a pulse schedule. During continuous operation of the VES and AIS systems, preferential air flow pathways develop in the soils which serve to limit the effective treatment zone. Pulsed operation of the system should allow a greater hydrocarbon recovery rate during the active period, while conserving energy during the down time. Based on our experience, in addition to correspondence with the ADEC, Shannon & Wilson recommends that the remediation system be operated on a pulse schedule consisting of alternating 0.5-hour periods of operation and down time.

We appreciate this opportunity to be of service and your continued confidence in our firm. If you have any questions or comments concerning this submittal, please call the undersigned.

Sincerely,

SHANNON & WILSON, INC.

Prepared by:

Matthew Hemry
Engineer III

Approved by:

Timothy Terry
Vice President

Enc: Table 1, Figures 1&2, Graphs 1-6, Appendices A&B

cc: Mr. Larry Frick
Mr. Mike Krueger

TABLE 1 - SUMMARY OF VAPOR AND GROUNDWATER ANALYTICAL RESULTS

Vapor Samples

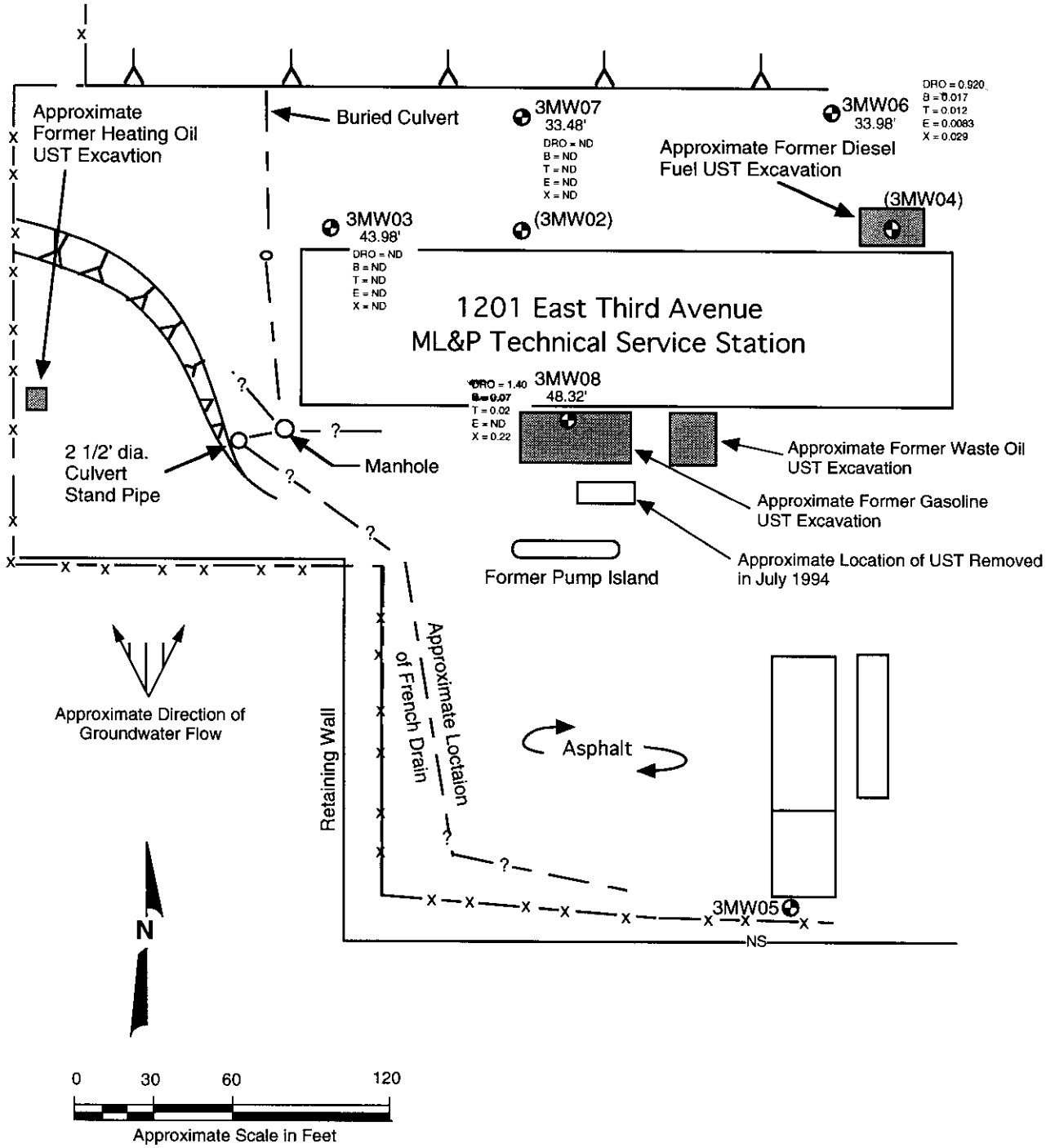
		Analytical Sample Number & Date (See Table A-1 and Appendix B)					
		VES14	VES16	VES17	VES18	VES19	VES20
Parameter Tested	**Method***	12/26/94	1/19/95	2/27/95	3/30/95	5/1/95	5/31/95
Exhasut Stack FID Reading - ppm	Sensidyne FID	120	50	70	15	8	4.5
Aromatic Volatile Organics (BTEX) - ppm	EPA 8020						
Benzene - ppm	EPA 8020	ND	ND	ND	ND	ND	ND
Toluene - ppm	EPA 8020	0.177	0.137	0.292	0.119	2.09	ND
Ethylbenzene - ppm	EPA 8020	0.063	ND	0.16	0.084	0.619	0.158
Xylenes - ppm	EPA 8020	0.308	0.383	0.53	0.417	1.756	0.255
Total BTEX - ppm	EPA 8020	0.548	0.52	0.982	0.62	4.465	0.413
Volatile Petroleum Hydrocarbons (VPH) - ppm	EPA 5030/8015M	1.07	3.31	13.4	3.16	9.49	5.27
Volatile Petroleum Hydrocarbons - lbs/day	Ideal Gas Law**	0.09	0.26	1.06	0.24	0.68	0.36

Water Samples

		Analytical Sample Number & Date (See Table A-3 and Appendix B)					
		MW3W3	MW6W3	MW8W3			
Parameter Tested	**Method***	1/19/95	1/19/95	1/19/95			
Diesel Range Organics (DRO) - ppm	EPA 3550/8100M	ND	0.970	4.100			
Aromatic Volatile Organics (BTEX) - ppm	EPA 602						
Benzene - ppm	EPA 602	ND	ND	1.60			
Toluene - ppm	EPA 602	ND	ND	2.50			
Ethylbenzene - ppm	EPA 602	ND	0.0009	0.35			
Xylenes - ppm	EPA 602	ND	0.0025	3.50			
Total BTEX - ppm	EPA 602	ND	0.0034	7.95			

		Analytical Sample Number & Date (See Table A-3 and Appendix B)					
		MW3W4	MW6W4	MW7W4	MW8W4		
Parameter Tested	**Method***	5/31/95	5/31/95	5/31/95	5/31/95		
Diesel Range Organics (DRO) - ppm	EPA 3550/8100M	ND	0.920	ND	1.400		
Aromatic Volatile Organics (BTEX) - ppm	EPA 602						
Benzene - ppm	EPA 602	ND	0.017	ND	0.07		
Toluene - ppm	EPA 602	ND	0.012	ND	0.02		
Ethylbenzene - ppm	EPA 602	ND	0.0083	ND	ND		
Xylenes - ppm	EPA 602	ND	0.029	ND	0.22		
Total BTEX - ppm	EPA 602	ND	0.0663	ND	0.31		

KEY	DESCRIPTION
ND	NOT DETECTED
--	NOT MEASURED FOR THIS PARAMETER
*	SEE APPENDIX A FOR DETECTION LIMITS



KEY

3MW03 43.98'	Number and approximate location of monitoring wells installed by Harding Lawson Associates; 43.98' groundwater elevation measured on 5/31/95
(3MW04)	Number and approximate location of monitoring wells destroyed during utility excavation activities, September, 1993
3MW06 33.98"	Number and approximate location of monitoring wells installed by Shannon & Wilson, May, 1994; 33.98' groundwater elevation measured on 5/31/95
DRO = ND B = ND T = ND E = ND X = ND	DRO & BTEX concentrations in ppm, May 31, 1995 groundwater monitoring round
NS	Not sampled during the most recent groundwater monitoring round

Site plan derived from Harding Lawson Associates, May 1993

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SITE PLAN

June 1995 Y-5216-3

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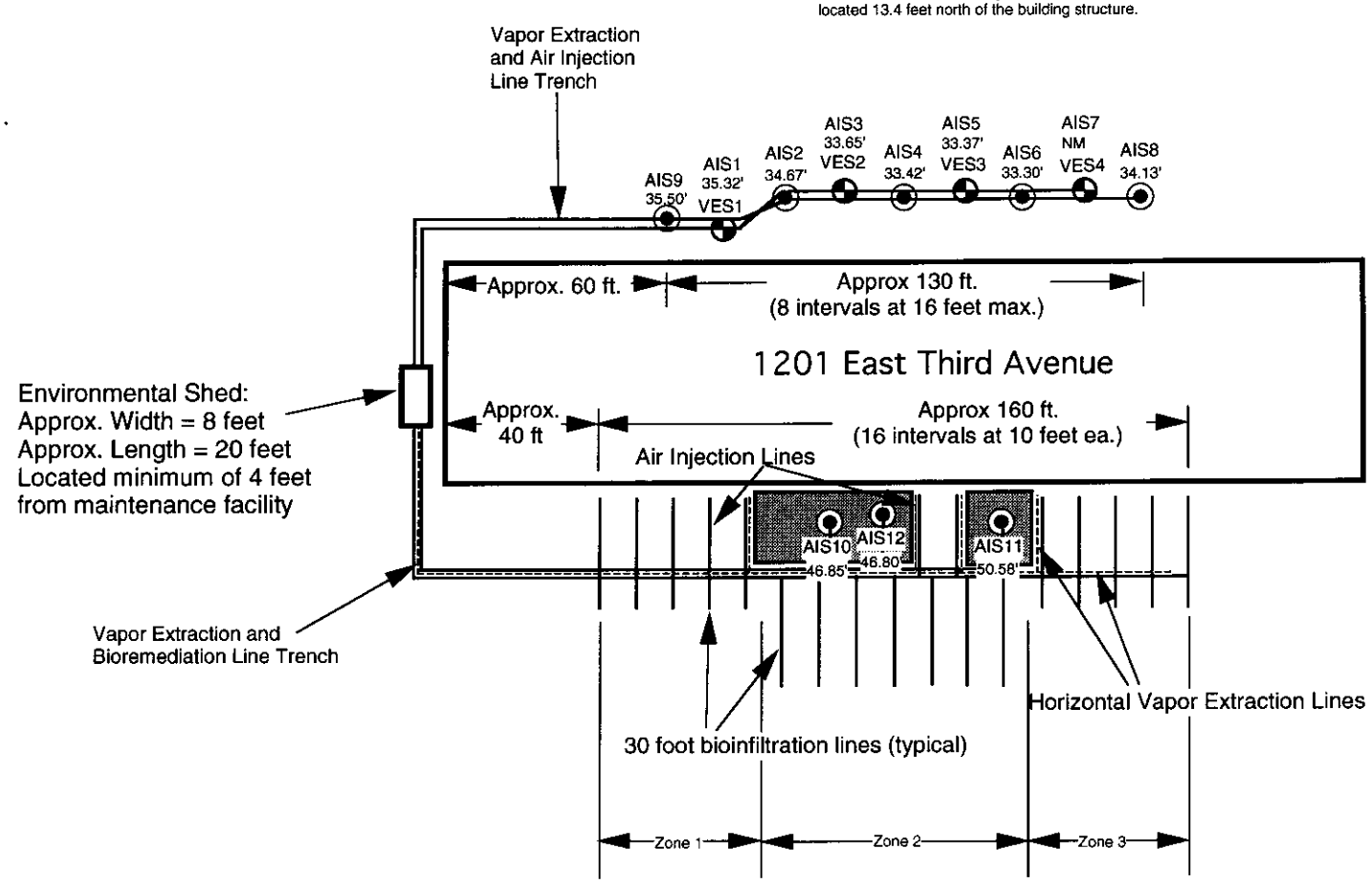
FIG. 1

NOTE: AIS wells AIS2 through AIS8 and VES wells VES2 through VES4 are located within 1.5 feet of an east-west axis located 17.0 feet north of the technical service facility. VES Well VES 4 is an exception, and is located 13.4 feet north of the building structure.



KEY

AIS1 VES1 — Co-located Vapor Extraction Well VES1 & Air Injection Well AIS1

AIS9 35.50' — Air Injection Well AIS9; 35.50' groundwater elevation measured on 5/31/95

Approximate Former Location of Gasoline and Waste Oil UST Excavations

0 25 50 100
Approximate Scale in Feet

N

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REMEDIATION LINE DETAIL

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Y-5216-3

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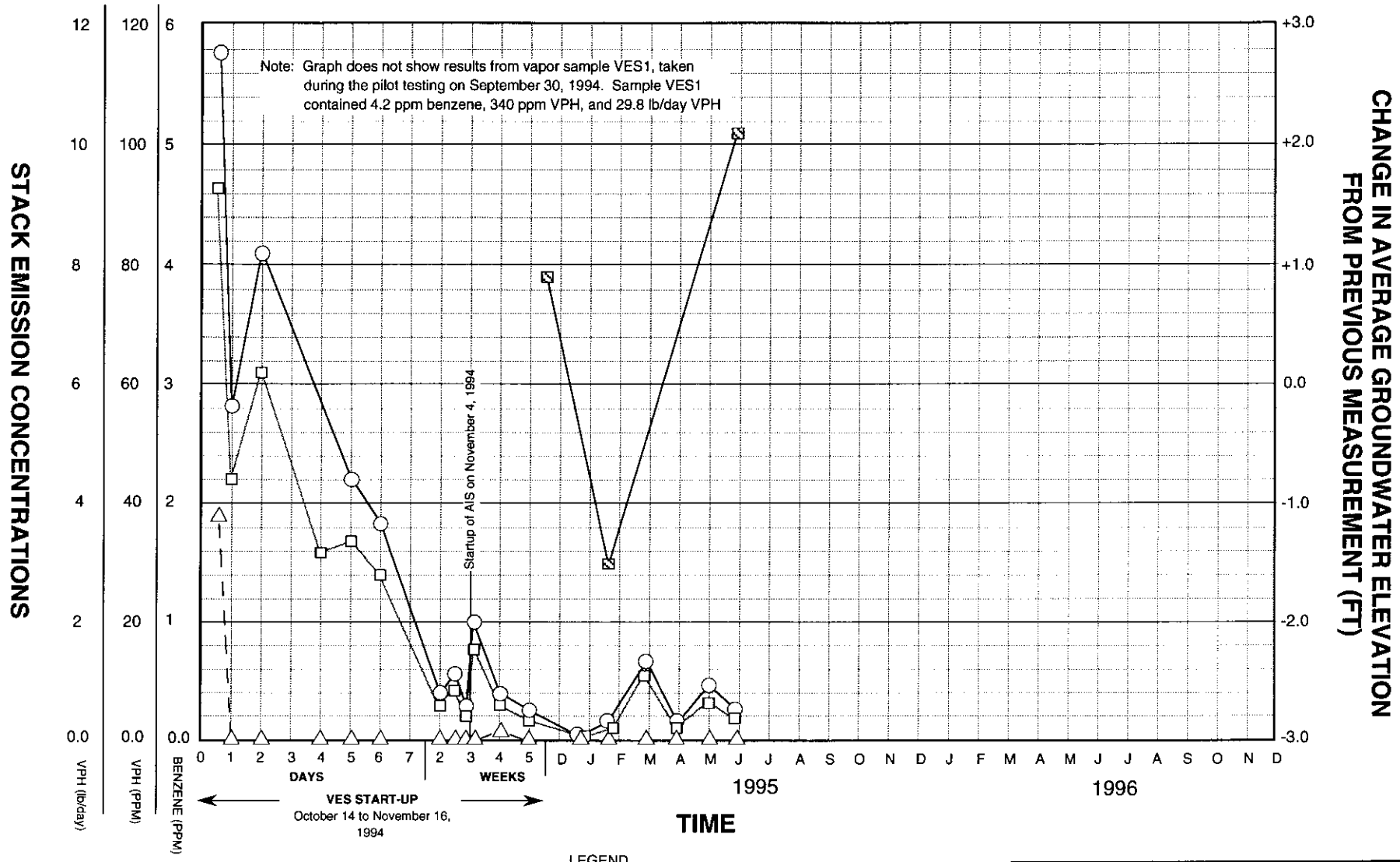
Fig. 2



LEGEND

- □ Exhaust Stack Vapor - VPH (lb/day)
- ○ Exhaust Stack Vapor - VPH (PPM)
- △ Exhaust Stack Vapor - Benzene (PPM)
- ⊠ Average Change in Groundwater Elevation in Two On-Site Monitoring Wells (feet)

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VAPOR CONCENTRATION VS. TIME TRENDS

June 1995 | Y-5216-3

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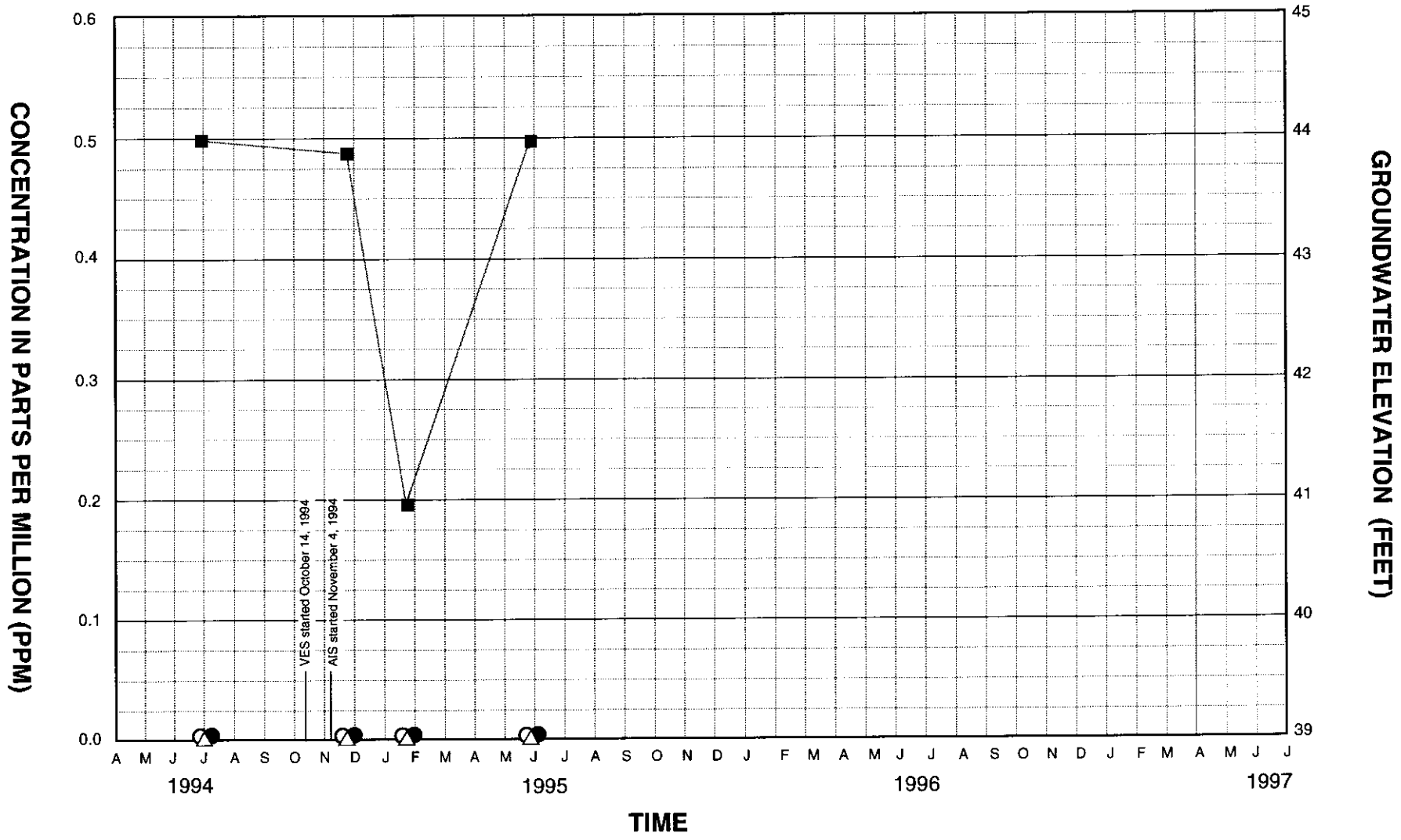
Graph 1



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW03 TRENDS

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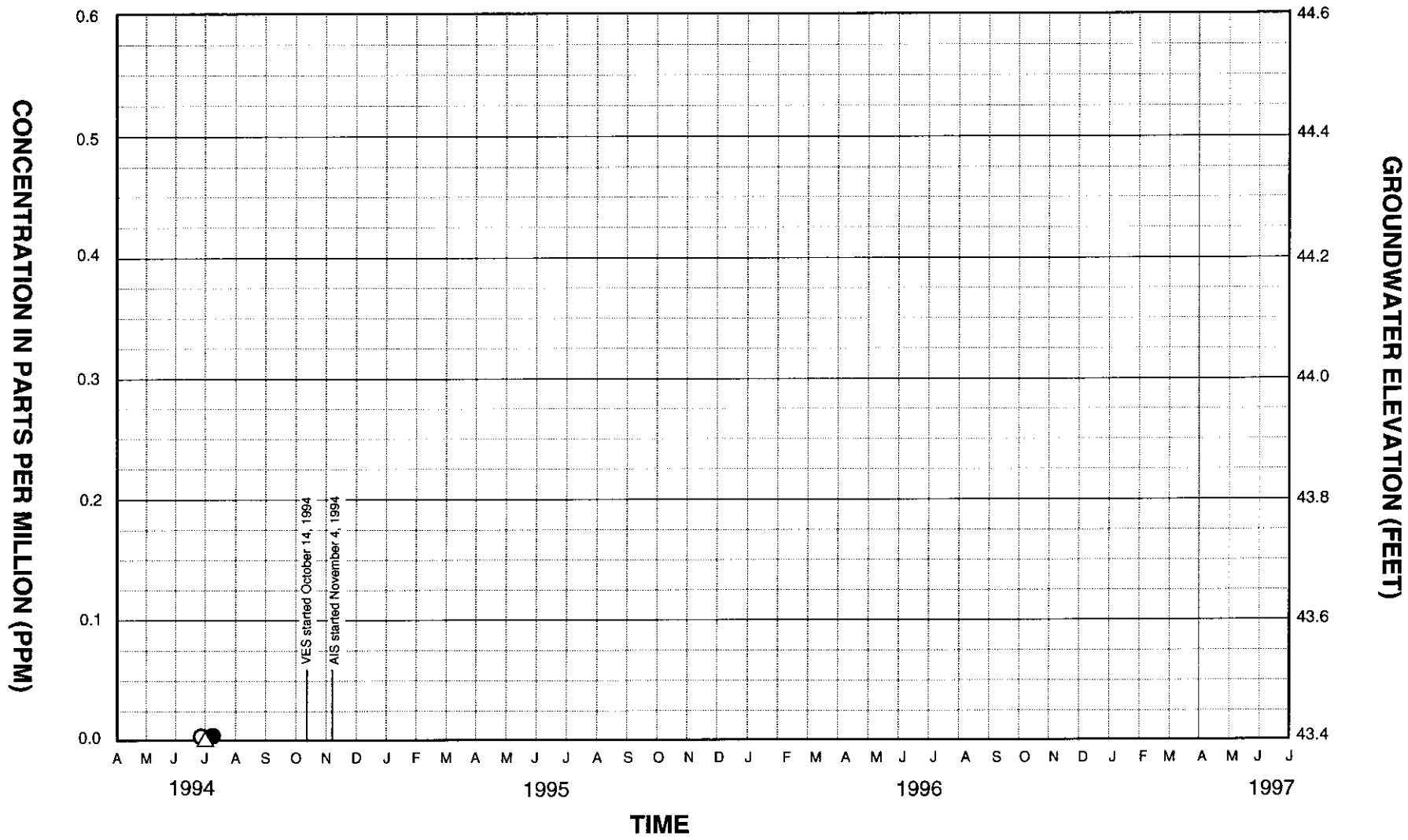
Graph 2

000193



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW05 TRENDS

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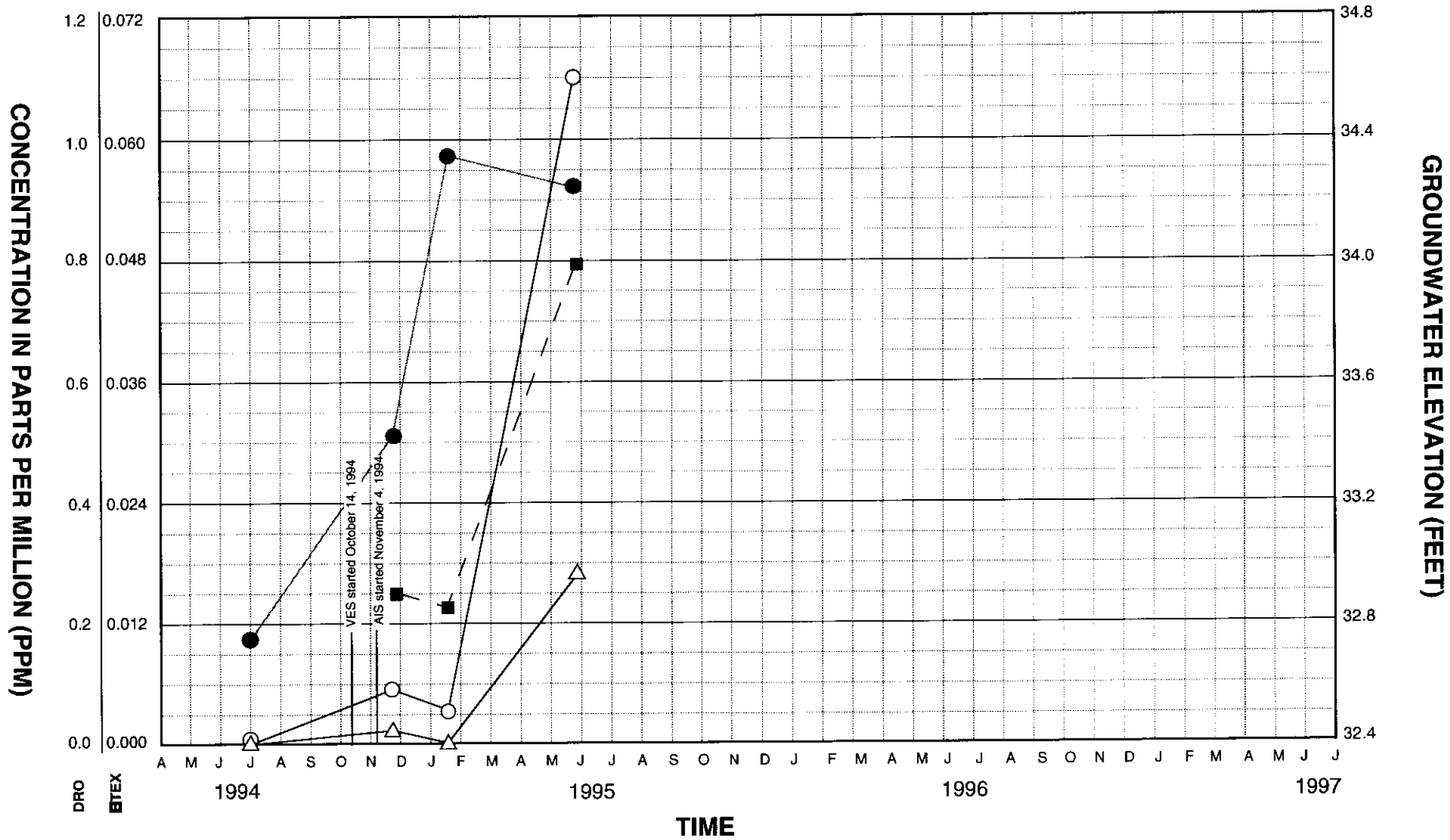
Graph 3



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW06 TRENDS

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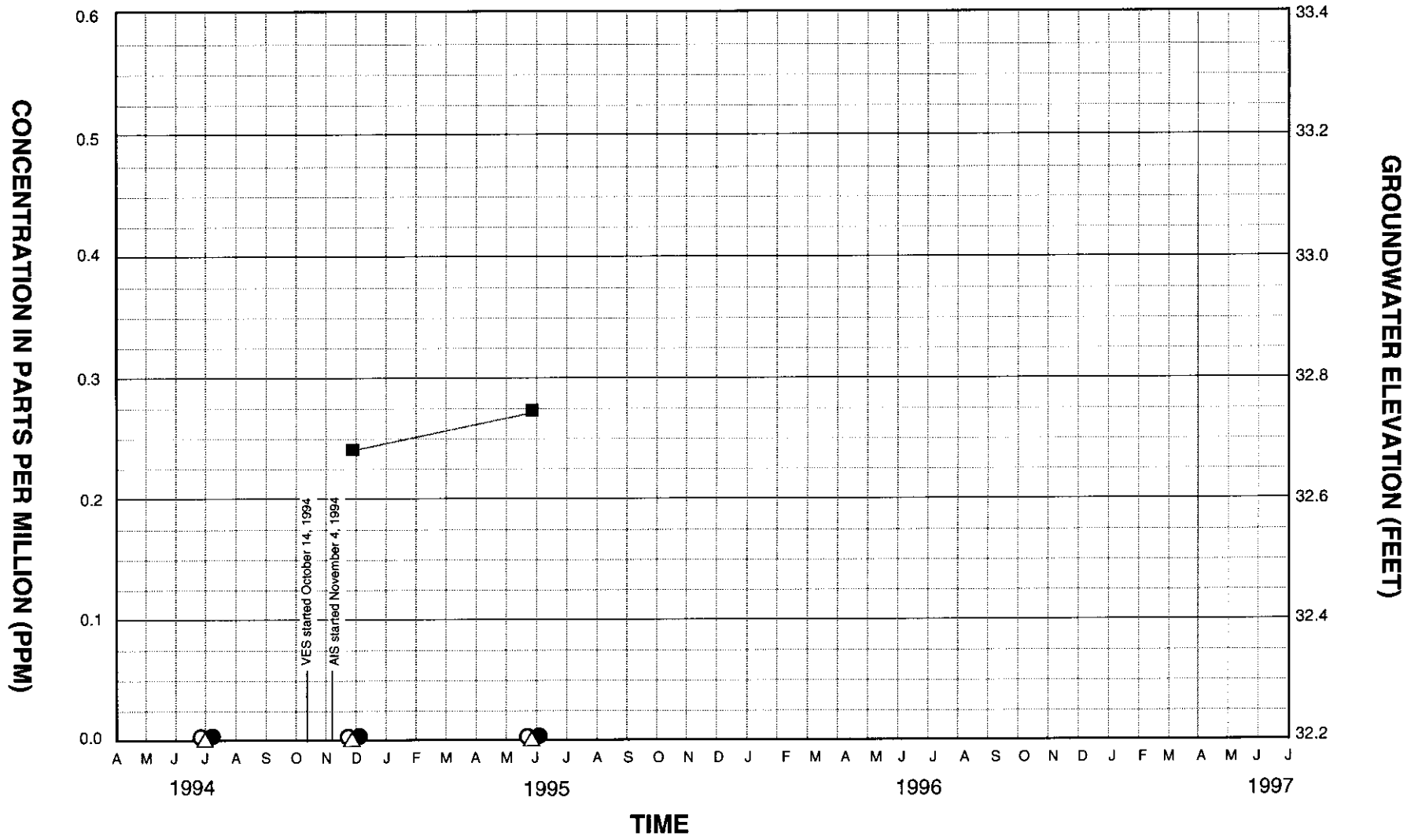
Graph 4

001195



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW07 TRENDS

June 1995 Y-5216-3

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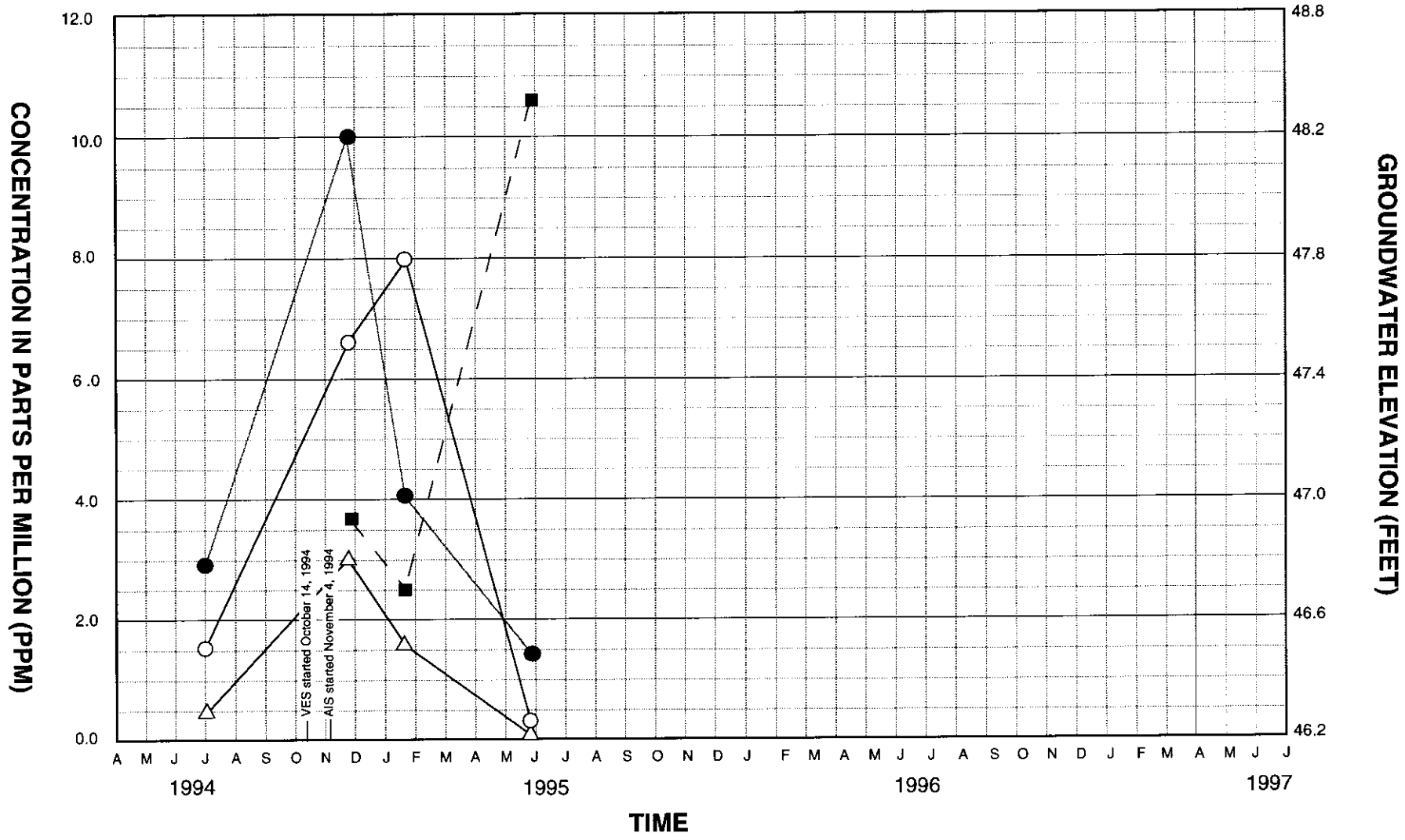
Graph 9



LEGEND

- △ BENZENE
- ○ TOTAL BTEX
- ● DRO
- ■ DEPTH TO GROUNDWATER

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MONITORING WELL MW08 TRENDS

June 1995 Y-5216-3

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Graph 6

00019

APPENDIX A

SYSTEM PERFORMANCE LOGS AND FIELD DATA FOR VES, AIS, AND GROUNDWATER MONITORING WELL SAMPLING

TABLE A-1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
12/26/94														
	15:10	Exhaust Stack	120		80	0.31		0	40			5%	1%	
	15:15	LINE1				0.15-0.25	1810							
	15:15	LINE2				0	0	0						
	15:15	LINE3				0	0	0						
	15:15	VES1				>0.25	>2050	>179						
	15:15	VES2				0.02	570	50						
	15:15	VES3				0.075	1110	97						
	15:15	VES4	Closed due to product in the well.											
	15:20	Analytical Sample Y-5216-3-VES14 collected												
	15:20	Exhaust Stack	120	1.07	80	0.33	2330	203	40			5%	1%	0.09
1/19/95														
	11:25	Exhaust Stack	35		76	0.3	2300	201	43			6%	1%	
	11:30	LINE1				erratic								
	11:30	LINE2				0.01	400	35						
	11:30	LINE3				0.005-0.01	400	35						
	11:30	VES1				>0.25	>2015	>176						
	11:30	VES2				0.02-0.025	635	55						
	11:30	VES3				0.075	1100	96						
	11:30	VES4	Closed due to product in the well.											
	11:40	Analytical Sample Y-5216-3-VES16 collected												
	11:40	Exhaust Stack	50	3.31	78	0.31	2260	197	42			6%	1%	0.26
2/27/95														
	15:20	Exhaust Stack	40		87	0.31	2275	199	44			6%	1%	
	15:30	LINE1	90			0.0-0.2	580	51						
	15:30	LINE2	100			0.015	500	44						
	15:30	LINE3	80			0.015	500	44						
	15:30	VES1	30			>0.25	>2075	>181						
	15:30	VES2	30			0.035	760	66						
	15:30	VES3	30			0.085	1190	104						
	15:30	VES4	Closed due to product in the well.											
	15:50	Analytical Sample Y-5216-3-VES17 collected												
	15:50	Exhaust Stack	70	13.4	85	0.31	2275	199	44			6%	1%	1.06

TABLE A-1 - VAPOR EXTRACTION SYSTEM (VES) MEASUREMENTS

Date	Time	Measurement Location/Note	FID ppm	VPH ppm	Temp F	Manometer (in H2O)	Velocity (fpm)	Flow Rate (scfm)	Drum vacuum (in. H20)	Oxygen (%)	Well Head vacuum (in. H20)	%LEL (Toxi-Guard A	%LEL (Toxi-Guard B	Vapor Discharge lbs/day
3/30/95														
	10:00	LINE1				erratic	NM	NM						
	10:00	LINE2				erratic	NM	NM						
	10:00	LINE3				0.035	750	65						
	10:00	VES1				NM	NM	NM						
	10:00	VES2				0.04	810	71						
	10:00	VES3				0.1	1270	111						
	10:00	VES4	Closed due to product in the well.											
	10:03	Analytical Sample Y-5216-3-VES18 collected												
	10:03	Exhaust Stack	15	3.16	78	0.28	2125	186	46			1%	0%	0.24
5/1/95														
	9:52	Exhaust Stack	12		88	0.26	2050	179	50					
	10:00	LINE1				erratic	NM	NM						
	10:00	LINE2				0.14-0.20	1690	148						
	10:00	LINE3				0.01	410	36						
	10:00	VES1				0	0	0						
	10:00	VES2				0.02	570	50						
	10:00	VES3				0.07	1070	93						
	10:00	VES4	Closed due to product in the well.											
	10:03	Analytical Sample Y-5216-3-VES19 collected												
	10:03	Exhaust Stack	8	9.49	92	0.27	2100	183	48-50			1%	0%	0.68
5/31/95														
	13:40	Exhaust Stack	4		102	0.24	2000	175	50					
	13:42	LINE1	1.5			0.055	960	84						
	13:46	LINE2	11			0.08	1165	102						
	13:50	LINE3	15			>0.25	>2050	>179						
	13:55	VES1	1			>0.25	>2050	>179						
	13:59	VES2	1.5			>0.25	>2050	>179						
	14:04	VES3	2			0.01	420	37						
	14:10	VES4	Closed due to product in the well.											
	14:22	Analytical Sample Y-5216-3-VES20 collected												
	14:20	Exhaust Stack	4.5	5.27	102	0.24	2000	175	52			1%	0%	0.36

† - Measurement taken with valves closed to all other VES lines
NM - Not Measured
ppm - parts per million
fpm - feet per minute
scfm - standard cubic feet per minute

002200

TABLE A-2 - AIR INJECTION SYSTEM (AIS) FIELD MEASUREMENTS

Date	Time	Measurement Location/Note	Velocity fpm	Air Flow scfm	Well Head Pressure inches water	Blower Pressure PSI	Water Elevation feet	DO ppm
5/31/95								
	13:00	AIS1	150	3.3				
	12:53	AIS2	60	1.3				
	13:11	AIS3	150	3.3				
	12:48	AIS4	160	3.5				
	12:50	AIS5	175	3.8				
	12:51	AIS6	175	3.8				
	13:09	AIS7	0	0.0				
	12:54	AIS8	0	0.0				
	13:01	AIS9	125	2.7				
	12:45	AIS10	100	2.2				
	12:46	AIS11	175	3.8				
	12:42	AIS12	200	4.4				
	13:30	Balanced each well to achieve uniform flow of 200 ft/min in each; blower pressure is 5.1 PSI						
	14:00	AIS1			81	5.1		
	14:04	AIS2			>100	5.1		
	14:08	AIS3			62	5.1		
	14:11	AIS4			53	5.1		
	14:13	AIS5			26	5.1		
	14:15	AIS6			31	5.1		
	14:17	AIS7			0	5.1		
	14:20	AIS8			0	5.1		
	14:41	AIS9			84	5.1		
	14:32	AIS10			100	5.1		
	14:35	AIS11			94	5.1		
	14:37	AIS12			52	5.1		
	13:39	MW-3			0	5.1		
	13:40	MW-6			0	5.1		
	13:41	MW-7			0	5.1		
	13:45	MW-8			0	5.1		
	14:41	AIS shut down						
	15:56	AIS1					35.32	5.47
	15:57	AIS2					34.67	6.12
	15:59	AIS3					33.65	5.64
	16:00	AIS4					33.42	3.84
	16:01	AIS5					33.37	4.06
	16:08	AIS6					33.3	4.91
		AIS7						
	16:06	AIS8					34.13	5.6
	15:55	AIS9					35.5	4.71
	15:50	AIS10					46.85	6.85
	15:51	AIS11					50.58	4.63
	15:53	AIS12					46.8	6.82
	15:10	MW-3					43.98	6.33
	15:22	MW-6					33.98	6.69
	15:71	MW-7					33.48	4.7
	15:00	MW-8					48.32	6

fpm - feet per minute
scfm - standard cubic feet per minute
ppm - parts per million

TABLE A-3 - WATER ELEVATION AND SAMPLING LOG

WATER LEVEL MEASUREMENT DATA

WELL NUMBER	AIS1	AIS2	AIS3^	AIS4	AIS5	AIS6†
DATE WATER LEVEL MEASURED	1/19/95	1/19/95	1/19/95	1/19/95	1/19/95	1/19/95
TIME WATER LEVEL MEASURED	14:25	14:20	NM	14:22	14:16	NM
MP ELEVATION, FT *	50.20	50.18	50.07	50.13	49.88	49.67
DEPTH TO WATER BELOW MP, FT	15.87	16.44	NM	17.60	17.45	NM
WATER LEVEL ELEVATION, FT	34.33	33.74	NM	32.53	32.43	NM

WELL NUMBER	AIS7†	AIS8	AIS9	AIS10^	AIS11	AIS12
DATE WATER LEVEL MEASURED	1/19/95	1/19/95	1/19/95	1/19/95	1/19/95	1/19/95
TIME WATER LEVEL MEASURED	NM	14:05	14:28	NM	14:56	14:36
MP ELEVATION, FT *	49.41	49.42	50.31	51.30	51.37	51.17
DEPTH TO WATER BELOW MP, FT	NM	16.48	15.77	NM	3.31	5.78
WATER LEVEL ELEVATION, FT	NM	32.94	34.54	NM	48.06	45.39

WELL NUMBER	MW03	MW05^	MW06	MW07^	MW08	
DATE WATER LEVEL MEASURED	1/19/95	1/19/95	1/19/95	1/19/95	1/19/95	
TIME WATER LEVEL MEASURED	13:38	NM	13:45	11:55	15:03	
MP ELEVATION, FT *	50.60	NM	51.51	49.25	51.43	
DEPTH TO WATER BELOW MP, FT	9.68	NM	18.65	NM	4.73	
WATER LEVEL ELEVATION, FT	40.92	NM	32.86	NM	46.70	

WELL NUMBER	AIS1	AIS2	AIS3	AIS4	AIS5	AIS6
DATE WATER LEVEL MEASURED	5/31/95	5/31/95	5/31/95	5/31/95	5/31/95	5/31/95
TIME WATER LEVEL MEASURED	15:56	15:57	15:59	16:00	16:01	16:08
MP ELEVATION, FT *	50.20	50.18	50.07	50.13	49.88	49.67
DEPTH TO WATER BELOW MP, FT	14.88	15.51	16.42	16.71	16.51	16.37
WATER LEVEL ELEVATION, FT	35.32	34.67	33.65	33.42	33.37	33.30

WELL NUMBER	AIS7†	AIS8	AIS9	AIS10	AIS11	AIS12
DATE WATER LEVEL MEASURED	5/31/95	5/31/95	5/31/95	5/31/95	5/31/95	5/31/95
TIME WATER LEVEL MEASURED	NM	16:06	15:55	15:50	15:51	15:53
MP ELEVATION, FT *	49.41	49.42	50.31	51.30	51.37	51.17
DEPTH TO WATER BELOW MP, FT	NM	15.29	14.81	4.45	0.79	4.37
WATER LEVEL ELEVATION, FT	NM	34.13	35.50	46.85	50.58	46.80

WELL NUMBER	MW03	MW05^	MW06	MW07	MW08	
DATE WATER LEVEL MEASURED	5/31/95	5/31/95	5/31/95	5/31/95	5/31/95	
TIME WATER LEVEL MEASURED	15:22	NM	15:31	15:26	15:18	
MP ELEVATION, FT *	50.60	NM	51.51	49.25	51.43	
DEPTH TO WATER BELOW MP, FT	6.62	NM	17.53	15.77	3.11	
WATER LEVEL ELEVATION, FT	43.98	NM	33.98	33.48	48.32	

KEY

MP = Measuring Point
NM = Not Measured
* = MP Elevation Surveyed by MOA
† = Water levels couldn't be taken due to product in the well
^ = Wells couldn't be located due to snow cover

TABLE A-3 - WATER ELEVATION AND SAMPLING LOG

SAMPLING/PURGING DATA

WELL NUMBER	MW03	MW05	MW06	MW07^	MW08	
DATE SAMPLED	1/19/95	NS	1/19/95	NS	1/19/95	
TIME SAMPLED	15:20	NS	15:30	NS	15:45	
DEPTH TO WATER BELOW MP, FT	9.68	NM	18.65	NM	4.73	
TOTAL DEPTH OF WELL BELOW MP, FT	22.20	13.70	24.00	21.10	12.30	
WATER COLUMN IN WELL, FT	12.52	NM	5.35	NM	7.57	
GALLONS PER FOOT	0.16	0.16	0.16	0.16	0.16	
GALLONS IN WELL	2.00	NM	0.86	NM	1.21	
TOTAL GALLONS PUMPED/BAILED	5.0	NS	5.0	NS	2.0	
TEMPERATURE, C	5.9	NM	6.5	NM	3.3	
SPECIFIC CONDUCTANCE, UMHOS/CM	460	NM	515	NM	483	
pH	7.23	NM	6.65	NM	6.97	
DISSOLVED OXYGEN, PPM	NM	NM	NM	NM	NM	
DIAMETER OF WELL CASING	2-inch	2-inch	2-inch	2-inch	2-inch	
REMARKS						

WELL NUMBER	MW03	MW05	MW06	MW07	MW08	
DATE SAMPLED	5/31/95	NS	5/31/95	5/31/95	5/31/95	
TIME SAMPLED	16:02	NS	16:24	15:26	16:09	
DEPTH TO WATER BELOW MP, FT	6.62	NM	17.53	15.77	3.11	
TOTAL DEPTH OF WELL BELOW MP, FT	19.89	13.70	24.10	20.96	8.72	
WATER COLUMN IN WELL, FT	13.27	NM	6.57	5.19	5.61	
GALLONS PER FOOT	0.16	0.16	0.16	0.16	0.16	
GALLONS IN WELL	2.12	NM	1.05	0.83	0.90	
TOTAL GALLONS PUMPED/BAILED	7.0	NS	4.0	3.0	3.0	
TEMPERATURE, C	NM	NM	6.5	8.1	10.5	
SPECIFIC CONDUCTANCE, UMHOS/CM	516	NM	747	352	454	
pH	6.47	NM	6.34	6.72	6.60	
DISSOLVED OXYGEN, PPM	2.52	NM	2.80	2.81	1.82	
DIAMETER OF WELL CASING	2-inch	2-inch	2-inch	2-inch	2-inch	
REMARKS						

KEY

MP = Measuring Point
NM = Not Measured
^ = Wells couldn't be located due to snow cover

0000204 L69.07

Transmittal Letter

To: Robert Weimer

Date: December 5, 1997

At: ADEC
Underground Storage Tank
Program
555 Cordova Street
Anchorage, AK 99501

Job No.: 973-5254x013

Sent Via: Mail

Quantity	Item	Description
1	Report	Reissue of Report for Groundwater Monitoring and Remediation, ML& P Site No. 3, 1201 E. Third Avenue, Anchorage, AK (October '96 - March '97)

RECEIVED
DEC 08 1997
Dept. of Environmental Conservation
Underground Storage Tanks — FAP

Remarks:

From: CB

Craig T. Boeckman
Project Manager

Golder Associates

1750 Abbott Road, Suite 200
Anchorage, Alaska 99507
Telephone (907) 344-6001
Fax (907) 344-6011

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