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FINAL MONTHLY ACTIVITIES REPORT MOBILE ENHANCED MULTI-PHASE EXTRACTION MILLINGTON SUPPACT TN

9/22/1999

BAT ASSOCIATES, INC.

MONTHLY ACTIVITIES REPORT

MOBILE ENHANCED MULTI-PHASE EXTRACTION (MEME) AT THE NAVAL EXCHANGE SERVICE STATION; NAVAL SUPPORT ACTIVITY MID-SOUTH, MILLINGTON, TENNESSEE

FACILITY I.D. No. 0-791718

FINAL September 22, 1999

Prepared by:

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Prepared for:

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Southern Division
Under Contract No. N62467-98-D-0938
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BAT PROJECT NO. 983019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1.0 PROJECT DESCRIPTION AND BACKGROUND

1.1 Project Description

BAT Associates, Inc. (BAT), under contract number N62467-98-D-0938, has been tasked by the Department of the Navy, Southern Division Engineering Facilities Command to perform mobile enhanced multi-phase extraction (MEME) technology at the Naval Exchange Service Station at the Naval Support Activity (NSA) MID-South, Millington, Tennessee (Facility I.D. No. 0-791718).

The application of the MEME events are intended to be an abatement initiative to reduce the levels of dissolved benzene, toluene, ethyl benzene, and xylene (BTEX), and total petroleum hydrocarbons (TPH) constituents in groundwater. This report summarizes data obtained from the MEME performed August 2, 1999. Field activities were conducted in accordance with BAT's approved final Plan of Action and the Tennessee Department of Environment and Conservation's (TDEC) Technical Guidance Document (TGD)-016.

1.2 Project Background

The Naval Exchange Service Station is located in the northwestern quadrant of NSA Memphis. The site encompasses approximately three acres, is flat, drains surfacially to the west, and is covered with asphalt pavement.

A loss of gasoline was discovered in February 1986 by Exchange Service Station personnel. The initial release was reported to TDEC in March 1986. A preliminary investigation of this leak by Navy personnel revealed that a pipe joint on the regular unleaded gasoline fuel line was leaking. As part of former site assessments, twenty-two (22) groundwater monitoring wells were installed.

Several groundwater monitoring events performed between 1987 and 1998 indicate that the contaminated groundwater has not moved from the immediate vicinity of the fuel line leak. TDEC has established that cleanup levels for groundwater for the "non-drinking water" classification is 0.070 ppm for benzene and 1.0 ppm for TPH. TPH and Benzene concentrations in the groundwater did exceed TDEC action levels for a non-drinking aquifer in ten (10) monitoring wells (MEM-757-1 through -3, MEM-757-6 through -8, MEM-757-12 through -14, and MEM-757-B3. Therefore, only these ten (10) wells were used for this MEME event. Location of the wells is shown on Figure 1-1.

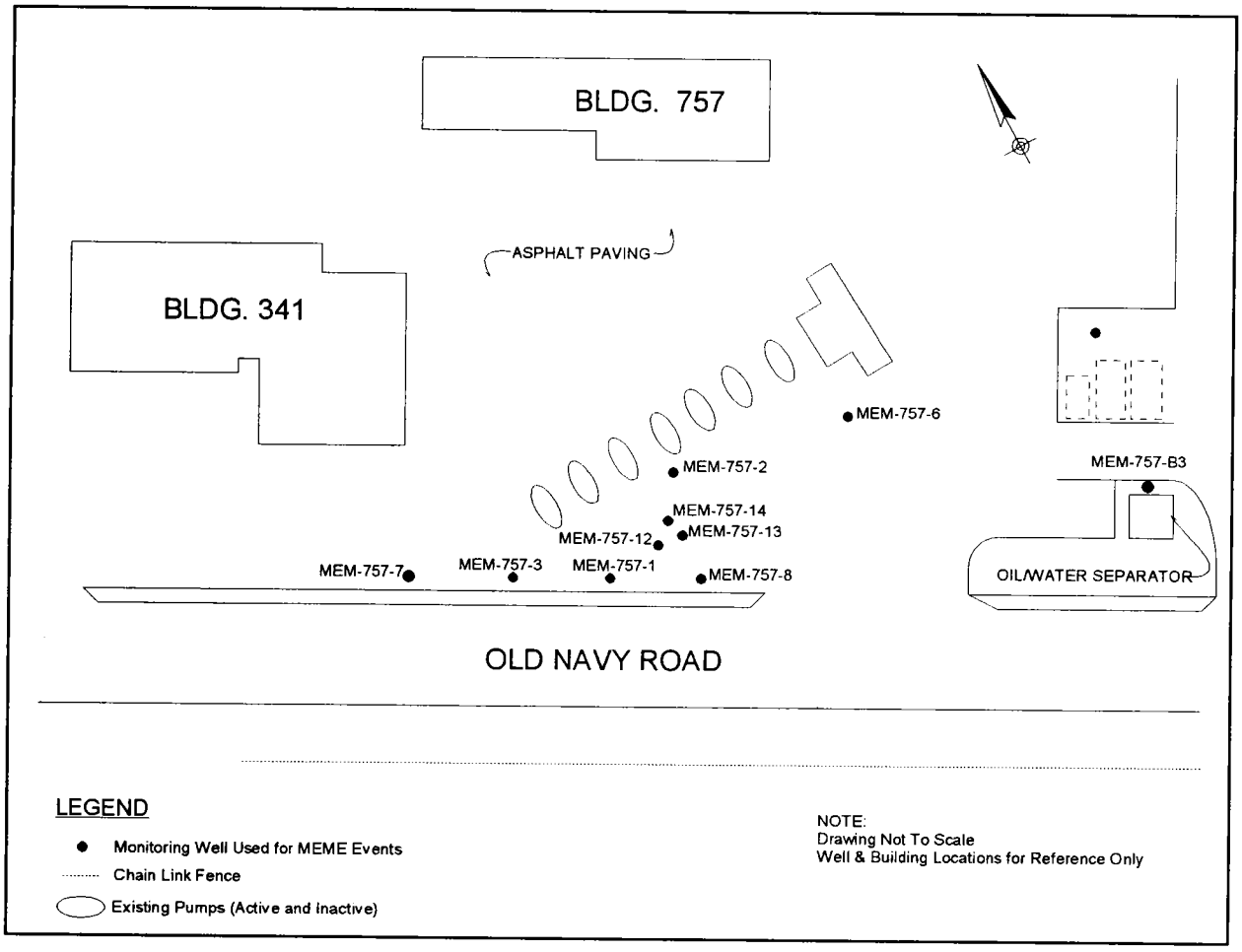

Figure 1-1 Site Map and Monitoring Well Locations

1.3 MEME Technology Employed

BAT utilized Enhanced Fluid Recovery (EFR™), a mobile variation of what is commonly referred to as multi-phase extraction, dual-phase extraction, and vacuum enhanced recovery. This technology is a remediation method that utilizes high vacuum pressures and flow rates to remove multiple phase (i.e. vapor, absorbed, dissolved, and free phase) volatile organic compounds (VOCs) from the subsurface. It utilizes high vacuum and high flow rates simultaneously connected to monitoring or recovery wells.

The MEME simultaneously removes vapors, free product, and groundwater from the subsurface. It volatizes adsorbed and free phase VOCs through a process similar to soil vapor extraction, but with much higher vacuum and radius of influence. MEME can also treat adsorbed phase VOCs existing in the "smear zone" (i.e. the zone of seasonal or climatic groundwater fluctuation) that act as a source for dissolved phase VOCs. MEME dewaters and exposes the smear zone to the effects of 'high rate" soil vapor extraction. MEME also introduces oxygen to the vadose zone and saturated zones, thereby enhancing aerobic biodegradation.

2.0 SUMMARY OF RESULTS

This MEME is the tenth event that has been conducted at this site. Nine previous events were conducted January 15-16, 1998 (initial event), January 29-30, 1998 (second event), January 19, 1999 (third event), February 10, 1999 (fourth event), March 15, 1999 (fifth event), April 15, 1999 (sixth event), May 17, 1999 (seventh event), June 18, 1999 (eighth event), and July 19, 1999 (ninth event).

Separate phase hydrocarbons (SPH) were not detected prior to, or upon completion of, conducting the August 2, 1999 MEME event. SPH has also not been detected during the previous nine MEME events. This MEME event was performed for a duration of eight hours at ten extraction points, consisting of the initial three hours at monitoring wells MEM-2, MEM-8, MEM-13, and MEM-14, the ensuing three hours at MEM-1, MEM-3, MEM-7, and MEM-12, and the final two hours at MEM-6 and B-3.

The first and second events were conducted over two days consisting of eight hours at wells MEM-1, MEM-2, MEM-3, MEM-7, MEM-8, MEM-12, MEM-13, and MEM-14 on the first day, and eight hours at wells MEM-6 and B3 on the second day. The third event was conducted for eight hours consisting of the initial three hours at monitoring wells MEM-2, MEM-8, MEM-13, and MEM-14, the ensuing three hours at wells MEM-1, MEM-3, MEM-7, and MEM-12, and the final two hours at MEM-6 and B-3. The fourth, fifth, sixth, seventh, eighth, and ninth events were conducted in the same configuration and for the same duration as this tenth event.

2.1 Petroleum Hydrocarbons Removed

A calculated total of 570 pounds of carbon (approximately equivalent to 926 pounds of adsorbed petroleum hydrocarbons - 153 equivalent gallons of gasoline) were removed during this MEME event. This recovered mass/volume of petroleum hydrocarbons represents a decrease from the removal achieved during the ninth event (i.e. a calculated total of 1,688 pounds of petroleum hydrocarbons - approximately 278 equivalent gallons of gasoline), and is within the lower range of removals achieved during previous events (i.e. calculated total of 499 to 3,704 pounds of petroleum hydrocarbons - approximately 82 to 611 equivalent gallons of gasoline). A combined total of 12,970 pounds of petroleum hydrocarbons (approximately 2,139 gallons of gasoline) have been recovered during the ten MEME events conducted at this site.

A summary of petroleum hydrocarbons removed to date is shown in Table 1.

TABLE 1
Summary of Petroleum Hydrocarbons Removed

MEME Event Number	MEME Event Date	Petroleum Hydrocarbons Removed (lbs.)	Equivalent Gasoline Removed (gal.)
1*	January 15 and 16, 1998	905	149
2*	January 29 and 30, 1998	581	95
3	January 19, 1999	3,704	611
4	February 10, 1999	1,307	216
5	March 15, 1999	1,839	304
6	April 15, 1999	499	82
7	May 17, 1999	687	113
8	June 18, 1999	834	138
9	July 19, 1999	1,688	278
10	August 2, 1999	926	153
	Total Removed To Date	**12,970**	**2,139**

*Performed by others

The carbon removal rate ranged from 2 to 233 pounds per hour during this MEME event. The removal rate decreased from 223 to 61 pounds per hour during the initial two hours of extraction from wells MEM-2, MEM-8, MEM-13, and MEM-14 and increased to 78 pounds per hour during the ensuing one hour. Upon commencement of extraction from wells MEM-1, MEM-3, MEM-7, and MEM-12, the carbon removal rate initially increased to 95 pounds per hour and generally decreased to 54 pounds per hour during the ensuing three hours of extraction. Upon commencement of extraction from MEM-6 and B-3, the carbon removal rate initially decreased from 2.9 pounds per hour and decreased to a final removal rate of 2.0 pounds per hour during the final 2 hours of this event. These removal rates were within the lower range of those generated during the last event (i.e. 1.7 to 404 pounds per hour) and during previous events (i.e. 0.7 to 1, 192 pounds per hour).

2.2 Offgas Concentrations

Offgas concentrations ranged from 1,200 to 82,000 ppm during this MEME event. Offgas concentrations decreased from 82,000 to 20,000 ppm during the initial two hours of extraction from MEM-2, MEM-8, MEM-13, and MEM-14 and increased to 32,000 ppm during the ensuing one hour.

Upon commencement of extraction from MEM-1, MEM-3, MEM-7, and MEM-12, offgas concentrations initially increased to 42,000 ppm and decreased to 20,000 ppm during the ensuing three hours of extraction. Upon commencement of extraction from wells MEM-6 and B-3, the offgas concentrations initially decreased to 1,600 ppm, further decreased to 1,200 ppm during the ensuing 0.5 hour, and remained at 1,200 ppm thereafter. These offgas concentrations were within the range of those recorded during the previous event (i.e. 600 to >100,000 ppm).

2.3 Flow Rates

Flow rates attained during this MEME event ranged from 257 to 403 CFM (152 to 265 dry standard CFM). The flow rates increased from 275 to 403 CFM during the initial four hours of this event and remained stable at 403 CFM during the ensuing two hours. Upon commencement of extraction from MEM-6 and B-3, the flow rates initially decreased to 293 CFM, decreased to 257 CFM during the ensuing 0.5 hour and remained at 257 CFM during the final 1.5 hours of the event. These flow rates ranged lower than those recorded during the last event (i.e. 378 to 504 CFM) and were within the lower range of those during previous events (i.e. 236 to 1,100 CFM).

2.4 Extraction Wellhead Vacuum Readings

The range of vacuum readings recorded at the extraction wells during this MEME event are detailed in the field data sheets (Appendix A) and are summarized in Table 2 below.

TABLE 2
Summary of Tenth Event Vacuum Readings

Extraction Well Location	Vacuum Reading (in. of mercury)
MEM-1	7 to 9
MEM-2	18 to 20
MEM-3	10 to 11
MEM-6	11 to 12
MEM-7	7 to 8
MEM-8	7
MEM-12	11 to 13
MEM-13	15 to 16
MEM-14	12 to 14
B-3	11

Differential pressures were recorded during this event at wells MEM-3 and MEM-6 to assess the vacuum induced by MEME in the vadose zone. Differential pressure data are detailed in Appendix A.

Groundwater levels were recorded during this event to determine drawdown of the aquifer during the MEME and is detailed below.

Monitoring Well	Maximum Change	Nearest Extraction Well Used For MEME Event (Approx. Distance)
MEM-3	-3.55 inches of water	MEM-14 (50 feet)
MEM-6	-2.10 / -1.50 inches of water	B-2 (75 feet) / MEM - 12 (90 feet)

2.5 Groundwater Disposal

Approximately 453 gallons of liquid (SPH was not detected in the vacuum truck tank upon conclusion of MEME activities) were removed during this MEME and off loaded to an on-base oil/water separator at the direction of the NSA environmental personnel.

2.6 Conclusions

Ten MEME events and five groundwater sampling events have been conducted at the site to date. Sampling was conducted by EnSafe Inc. on April 11, 1996 (initial sampling event), March 3, 1998 (second event), September 4, 1998 (third event), February 25, February 26, and March 1, 1999 (fourth event), and August 10, 11, 12 and 18, 1999 (fifth event). The fourth and fifth sampling events were conducted in conjunction with the ten MEME events performed by BAT. Table 3 shows the results from the first, fourth, and fifth sampling events.

Analytical data from the fourth sampling event showed a trend that indicated the MEME application was somewhat effective in reducing the levels of dissolved BTEX and total TPH constituents in the groundwater. However, analytical data from the fifth sampling event indicate that the levels of TPH are not being aggressively reduced. Of the ten wells used for the MEME application, one well (MEM-757-B3) has exhibited a trend in the reduction of Benzene and TPH, and is below the TDEC "non-drinking water" classification cleanup levels for groundwater (0.070 ppm for benzene and 1.0 ppm for TPH). The other nine wells are still substantially above the established cleanup levels.

Current groundwater contamination levels are two orders of magnitude above regulatory cleanup levels. Continuation of MEME will likely capture contamination but will not effectively or aggressively address the source of contamination. A remedial approach which addresses the source would offer better results and possibly shorten the overall duration of the cleanup effort.

2.7 Recommendations

Plans are currently being made to close the service station located at the site within the next 12-18 months. BAT recommends that the MEME application be discontinued and that the contamination present be addressed as part of the closure assessment.

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APPENDIX A

MEME FIELD DATA SHEETS

EFR® FIELD DATA SHEET

Client: BAT Environmental	Facility Name: NEX (Navy Exchange) Auto Part/Fuel Lock	Facility ID#: 0-791718	Event #: 10
Facility Address: 757 Old Navy Road, Millington, Tennessee		Technician: Lewis	Date: 8/2/99

Extraction Well(s)	Start Time (hh:mm)	End Time (hh:mm)	Interval Time (min)	Extraction Well-head Vacuum (in. Hg)											Offgas Velocity (ft/min)	Total Flow (CFM)	Stack Gas Temp. (° F)	Total Flow (DSCFM)	Offgas Concentrations			Rate of Carbon Removal (lbs/hour)	Total Carbon Removed (pounds)
				Inlet	MEM-1	MEM-2	MEM-3	MEM-6	MEM-7	MEM-8	MEM-12	MEM-13	MEM-14	B-3					Initial PPM_V	Ending PPM_V	Average PPM_V		
MEM-2,8,13,14	10:00	10:15	15	20	-	20	-	-	-	7	-	16	14	-	1,500	275	90	262	82,000	70,000	76,000	223	56
"	10:15	10:30	15	19	-	19	-	-	-	7	-	15	13	-	1,700	312	130	265	70,000	64,000	67,000	199	50
"	10:30	10:45	15	19	-	18	-	-	-	7	-	15	13	-	1,800	330	140	265	64,000	60,000	62,000	184	46
"	10:45	11:00	15	19	-	18	-	-	-	7	-	15	13	-	1,800	330	160	223	60,000	56,000	58,000	145	36
"	11:00	11:30	30	18	-	18	-	-	-	7	-	15	12	-	2,000	367	170	217	56,000	30,000	43,000	105	52
"	11:30	12:00	30	18	-	18	-	-	-	7	-	15	12	-	2,000	367	170	217	30,000	20,000	25,000	61	30
"	12:00	12:30	30	18	-	18	-	-	-	7	-	15	12	-	2,000	367	170	217	20,000	32,000	26,000	63	32
"	12:30	13:00	30	18	-	18	-	-	-	7	-	15	12	-	2,000	367	170	217	32,000	32,000	32,000	78	39
MEM-1,3,7,12	13:00	13:15	15	17	7	-	10	-	7	-	11	-	-	-	2,000	367	170	217	42,000	36,000	39,000	95	24
"	13:15	13:30	15	17	7	-	10	-	7	-	11	-	-	-	2,000	367	170	217	36,000	30,000	33,000	80	20
"	13:30	14:00	30	18	8	-	11	-	8	-	12	-	-	-	2,200	403	170	239	30,000	36,000	33,000	88	44
"	14:00	14:30	30	18	9	-	11	-	8	-	13	-	-	-	2,200	403	170	239	36,000	30,000	33,000	88	44
"	14:30	15:00	30	18	9	-	11	-	8	-	13	-	-	-	2,200	403	170	239	30,000	26,000	28,000	75	37
"	15:00	15:30	30	18	9	-	11	-	8	-	13	-	-	-	2,200	403	170	239	26,000	20,000	23,000	62	31
"	15:30	16:00	30	18	9	-	11	-	8	-	13	-	-	-	2,200	403	170	239	20,000	20,000	20,000	54	27
MEM-6;B-3	16:00	16:15	15	18	-	-	-	12	-	-	-	-	-	11	1,600	293	170	174	1,600	1,400	1,500	2.9	0.7
"	16:15	16:30	15	17	-	-	-	12	-	-	-	-	-	11	1,600	293	170	174	1,400	1,200	1,300	2.5	0.6
"	16:30	17:00	30	16	-	-	-	11	-	-	-	-	-	11	1,400	257	170	152	1,200	1,200	1,200	2.0	1.0
"	17:00	17:30	30	16	-	-	-	11	-	-	-	-	-	11	1,400	257	170	152	1,200	1,200	1,200	2.0	1.0
"	17:30	18:00	30	16	-	-	-	11	-	-	-	-	-	11	1,400	257	170	152	1,200	1,200	1,200	2.0	1.0

Vacuum Truck Information

Subcontractor:	NB Env.
Invoice No.:	1587
Truck Operator:	Lowe
Truck No.:	KingVac VK-39
Vacuum Pump Type:	Liquid Ring
Tank Capacity:	2,561
Stack I.D. (inches):	5.8
Calibration Gas:	500 ppm Hexane
Molecular Weight:	75 g/mole

Well No.	Breather Port (CFM)	Stinger Depth (feet)
MEM-1	0 (closed)	10
MEM-2	0 (closed)	10
MEM-3	0 (closed)	10
MEM-6	0 (closed)	10
MEM-7	0 (closed)	10
MEM-8	0 (closed)	10
MEM-12	0 (closed)	10
MEM-13	0 (closed)	10
MEM-14	0 (closed)	10
B-3	0 (closed)	10

Recovery/Disposal Information

Total Gal. of Liquid:	453
Disposal Facility:	*
Manifest No.:	*
Total Lbs. of Carbon (Offgas):	573
Cum. Lbs. Carbon Removed:	9,188
Lbs. Hydrocarbons Removed:	930
Cum. Lbs. Hydrocarbons:	12,974
Equiv. Gal. Removed:	154
Cum. Equiv. Gal. Removed:	2,140

ECOVAC SERVICES

Comments: * Offloaded extracted liquid to an on-site oil/water separator

EFR® EVENT GAUGING DATA

Client: BAT Environmental	Facility Name: NEX (Navy Exchange) Auto Part/Fuel Lock	Facility ID#: 0-791718	Event #: 10
Facility Address: 757 Old Navy Road, Millington, Tennessee		Technician: Lewis	Date: 8/2/99

Well Designation	Well Diameter (inches)	Total Depth (feet)	Before EFR® Event			After EFR® Event			Depth to Liquid Change (feet)
			Depth to SPH (feet)	Depth to Water (feet)	SPH Thickness (feet)	Depth to SPH (feet)	Depth to Water (feet)	SPH Thickness (feet)	
MEM-1	4		-	5.84	0.00	-	9.90	0.00	-4.06
MEM-2	4		-	4.84	0.00	-	10.40	0.00	-5.56
MEM-3	4		-	5.78	0.00	-	9.80	0.00	-4.02
MEM-6	4		-	5.40	0.00	-	10.00	0.00	-4.60
MEM-7	4		-	5.83	0.00	-	9.90	0.00	-4.07
MEM-8	4		-	6.28	0.00	-	10.20	0.00	-3.92
MEM-11	4		-	6.52	0.00	-	6.73	0.00	-0.21
MEM-12	4		-	6.68	0.00	-	11.20	0.00	-4.52
MEM-13	4		-	5.77	0.00	-	11.10	0.00	-5.33
MEM-14	6		-	5.82	0.00	-	10.70	0.00	-4.88
MEM-16	6		-	8.75	0.00	-	8.79	0.00	-0.04
B-3	4		-	7.87	0.00	-	9.70	0.00	-1.83
B-4	4		-	7.52	0.00	-	7.54	0.00	-0.02

ECOVAC SERVICES

Comments:

Differential Pressure and Groundwater Drawdown Data Recorded During EFR®
Event No. 10 (August 2, 1999)
NEX (Navy Exchange) Auto Part/Fuel Lock
757 Old Navy Road
Millington, Tennessee

DIFFERENTIAL PRESSURE DATA

		Well Designation:	
		MEM-3	MEM-6
Nearest Extraction Well:		MEM-14	MEM-2/MW-12
Approximate Distance:		50 feet	75 feet/90 feet
Time	Elapsed Time	Differential Pressure Readings (inches of water):	
11:00	1.0 hr.	-1.02	-1.80
11:30	1.5 hrs.	-3.50	-1.93
12:00	2.0 hrs.	-3.50	-2.02
13:00	3.0 hrs.	-3.55	-2.10
15:00	5.0 hrs.	-	-1.50
Maximum Change:		-3.55	-2.10