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

4/12/1999

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 April 12, 1999

Prepared by:

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Prepared for:

Department of the Navy
Southern Division
Under Contract No. N62467-98-D-0938
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BAT PROJECT NO. 983019

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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 March 15, 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.

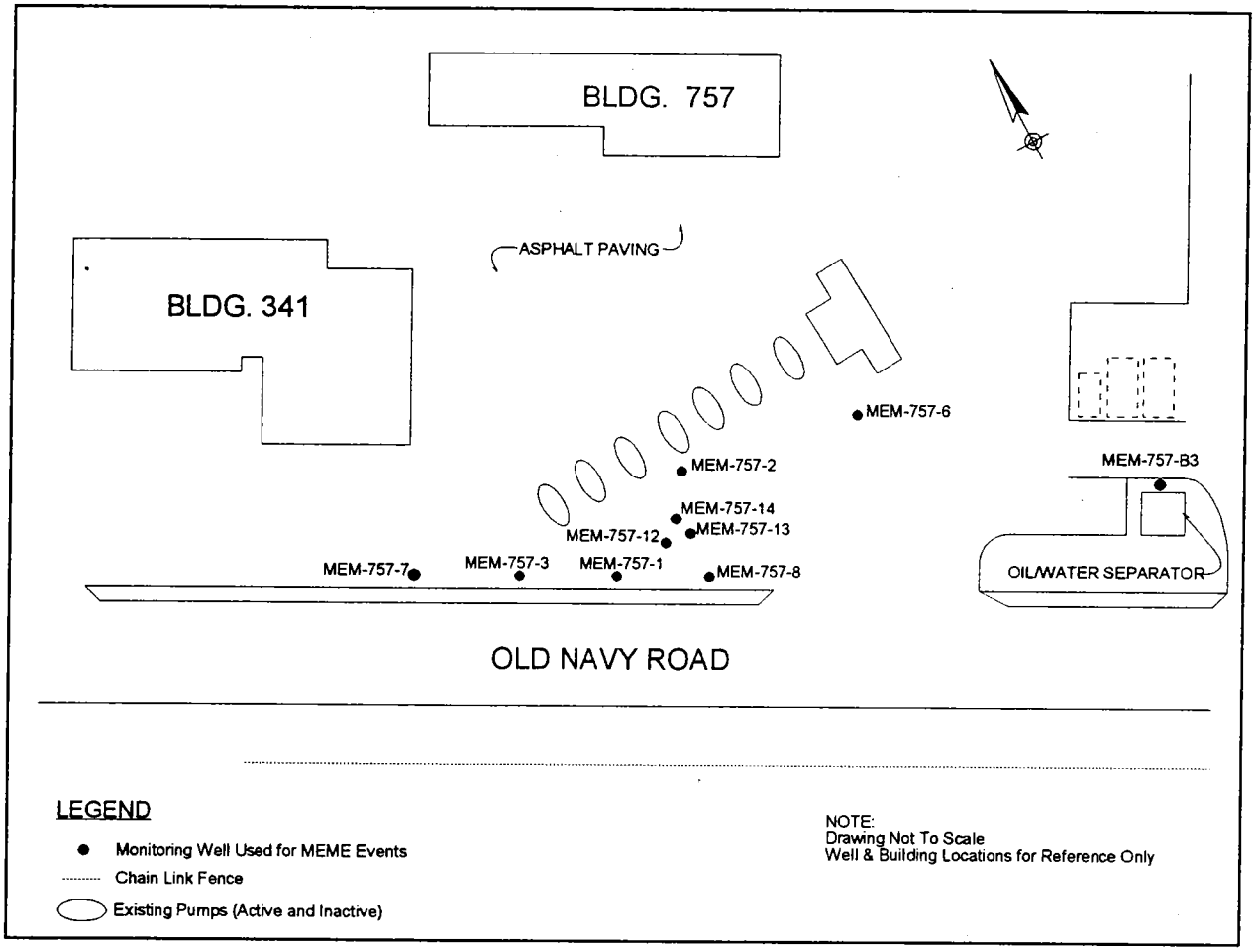

Figure 1-1 Site Map and Monitoring Well Locations

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 fifth event that has been conducted at this site. Four previous events were conducted January 15-16, 1998 (initial event), January 29-30, 1998 (second event), January 19, 1999 (third event), and February 10, 1999 (fourth event).

Separate phase hydrocarbons (SPH) were not detected prior to, or upon completion of, conducting the March 15, 1999 MEME event. SPH has also not been detected during the previous four 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 six hours at monitoring well MEM-1, MEM-2, MEM-3, MEM-7, MEM-8, MEM-12, MEM-13, and MEM-14 and the final two hours at MEM-6 and B-3. The fourth event was conducted in the same configuration and for the same duration as this fifth event.

2.1 Petroleum Hydrocarbons Removed

A calculated total of 1,404 pounds of carbon (approximately equivalent to 1,839 pounds of petroleum hydrocarbons - 304 equivalent gallons of gasoline) were removed during this MEME event. This recovered mass/volume of petroleum hydrocarbons represents an increase from the removals achieved during the fourth event (i.e. a calculated total of 1,307 pounds of petroleum hydrocarbons - approximately 216 equivalent of gasoline), and is within the range of removals achieved during previous events (i.e. calculated total of 581 to 3,704 pounds of petroleum hydrocarbons - approximately 95 to 611 equivalent gallons of gasoline). A calculated total of 8,336 pounds of petroleum hydrocarbons (approximately 1,375 gallons of gasoline) have been recovered during the five 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
	Total Removed To Date	**8,336**	**1,375**

*Performed by others

The carbon removal rate ranged from 1.2 to 392 pounds per hour during this MEME event. The removal rate decreased from 392 to 133 pounds per hour during the initial three hours of extraction from wells MEM-2, MEM-8, MEM-13, and MEM-14. Upon commencement of extraction from wells MEM-1, MEM-3, MEM-7, and MEM-12, the carbon removal rate decreased from 354 to 109 pounds per hour during the ensuing three hours of extraction. Upon commencement of extraction from MEM-6 and B-3, the carbon removal rate generally decreased to 2.3 to 1.2 pounds per hour during the final two hours of this event. These removal rates encompassed the range of removal rates achieved during the fourth event (i.e. 1.7 to 315 pounds per hour) and ranged lower than those achieved during previous events (i.e. 3 to 1,192 pounds per hour).

2.2 Offgas Concentrations

Offgas concentrations ranged from 360 to >100,000 ppm during this MEME event. Offgas concentrations decreased from 100,000 to 32,000 ppm during the initial three hours of extraction from MEM-2, MEM-8, MEM-13, and MEM-14. Upon commencement of extraction from MEM-1, MEM-3, MEM-7, and MEM-12, offgas concentrations decreased from >100,000 to 24,000 ppm during the ensuing three hours of extraction. Upon commencement of extraction from wells MEM-6 and B-3, the offgas concentrations increased from 1,000 to 1,400 ppm during the initial 0.5 hour and decreased to 360 ppm during the final 1.5 hours of this event. These offgas concentrations encompassed the range of concentrations recorded during the fourth event (i.e. 620 to 90,000 ppm) and ranged lower than those recorded during previous events (i.e. 700 to >100,000 ppm).

2.3 Flow Rates

Flow rates attained during this MEME event ranged from 236 to 433 CFM (160 to 350 DSCFM),

including approximately 0 to 28 CFM attributed to atmospheric air inflow at the MEM-2, MEM-6, and B-3 wellhead breather ports, respectively. Breather ports are sometimes utilized to enhance the recovery of petroleum hydrocarbons and/or groundwater. The flow rate increased from 362 to 409 CFM during the initial three hours of extraction from MEM-2, MEM-8, MEM-13, and MEM-14. Upon commencement of extraction from MEM-1, MEM-3, MEM-7, and MEM-12, the flow rate increased from 409 to 433 CFM during the ensuing three hours of extraction. Upon commencement of extraction from wells MEM-6 and B-3, the flow rate increased from 236 to 268 CFM during the final two hours of this event. These flow rates ranged lower than those recorded during the fourth event (i.e. 257 to 477 CFM) and during previous events (i.e. 257 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 Fifth Event Vacuum Readings

Extraction Well Location	Vacuum Reading (in. of mercury)
MEM-1	9 to 10
MEM-2	15 to 17
MEM-3	14 to 15
MEM-6	15 to 16
MEM-7	9 to 10
MEM-8	6 to 7
MEM-12	14 to 15
MEM-13	16 to 18
MEM-14	14 to 16
B-3	10 to 14

The vacuum readings recorded at extraction wells MEM-2, MEM-6, and B-3 may have been biased by atmospheric air inflow at the wellhead breather port.

Differential pressures were recorded during this event to assess the vacuum induced by MEME in the vadose zone. These data are detailed in Appendix A and summarized below.

Monitoring Well	Maximum Change	Nearest Extraction Well (Approx. Distance)
MEM-12	-0.02 inches of water	MEM-14 (9 feet)
MEM-3	0.00 inches of water	MEM-14 (50 feet)
B-4	-0.45 inches of water	B-3 (54 feet)
MEM-6	-0.61 inches of water	MEM-2 (75 feet)
MEM-16	0.00 inches of water	B-3 (75 feet)

Groundwater levels were recorded during this event to determine drawdown of the aquifer during this MEME. These data are detailed in Appendix A and are summarized below.

Monitoring Well	Maximum Change	Nearest Extraction Well (Approx. Distance)
MEM-11	-0.67	MEM-8 (37 feet)
B-4	-0.24	B-3 (54 feet)
MEM-16	-0.27	B-3 (75 feet)

2.5 Groundwater Disposal

Approximately 1,716 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.

APPENDIX A

MEME FIELD DATA SHEETS

EFR® FIELD DATA SHEET

Client: BAT Env. | Facility Name: NEX (Navy Exchange) Auto Part/Fuel Lock

Facility Address: 757 Old Navy Road, Millington, Tennessee

Facility ID#: 0-791718 | Technician: Lewis | Event #: 5 | Date: 3/15/99

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	8:00	8:15	15	20	-	17	-	-	-	6	-	18	16	-	4,600	362	80	350	100,000	100,000	100,000	392	98
"	8:15	8:30	15	20	-	17	-	-	-	7	-	18	16	-	4,600	362	110	331	100,000	100,000	100,000	371	93
"	8:30	8:45	15	19	-	16	-	-	-	7	-	17	15	-	4,800	378	130	321	100,000	100,000	100,000	360	90
"	8:45	9:00	15	18	-	15	-	-	-	7	-	16	14	-	5,000	394	140	316	100,000	100,000	100,000	355	89
"	9:00	9:30	30	18	-	15	-	-	-	7	-	16	14	-	5,000	394	140	316	100,000	80,000	90,000	319	160
"	9:30	10:00	30	18	-	15	-	-	-	7	-	16	14	-	5,000	394	140	316	80,000	50,000	65,000	230	115
"	10:00	10:30	30	18	-	15	-	-	-	7	-	16	14	-	5,200	409	140	329	50,000	40,000	45,000	166	83
"	10:30	11:00	30	18	-	15	-	-	-	7	-	16	14	-	5,200	409	140	329	40,000	32,000	36,000	133	66
MEM-1,3,7,12	11:00	11:15	15	18	9	-	14	-	9	-	15	-	-	-	5,200	409	140	329	100,000	92,000	96,000	354	88
"	11:15	11:30	15	18	9	-	14	-	9	-	15	-	-	-	5,200	409	140	329	92,000	84,000	88,000	324	81
"	11:30	12:00	30	18	9	-	15	-	9	-	15	-	-	-	5,200	409	150	306	84,000	60,000	72,000	247	123
"	12:00	12:30	30	17	9	-	15	-	10	-	15	-	-	-	5,400	425	150	317	60,000	52,000	56,000	199	100
"	12:30	13:00	30	17	9	-	15	-	10	-	15	-	-	-	5,400	425	150	317	52,000	44,000	48,000	171	85
"	13:00	13:30	30	18	10	-	15	-	10	-	14	-	-	-	5,500	433	140	348	44,000	32,000	38,000	148	74
"	13:30	14:00	30	18	10	-	15	-	10	-	14	-	-	-	5,500	433	140	348	32,000	24,000	28,000	109	55
MEM-6;B-3	14:00	14:15	15	18	-	-	-	16	-	-	-	-	-	10	3,000	236	140	190	1,000	1,200	1,100	2.3	0.6
"	14:15	14:30	15	18	-	-	-	16	-	-	-	-	-	12	3,000	236	150	176	1,200	1,400	1,300	2.6	0.6
"	14:30	15:00	30	18	-	-	-	15	-	-	-	-	-	14	3,000	236	160	160	1,400	1,000	1,200	2.2	1.1
"	15:00	15:30	30	17	-	-	-	15	-	-	-	-	-	14	3,200	252	160	171	1,000	800	900	1.7	0.9
"	15:30	16:00	30	17	-	-	-	15	-	-	-	-	-	14	3,400	268	160	181	800	360	580	1.2	0.6

Vacuum Truck Information

Subcontractor:	NB Env.
Invoice No.:	
Truck Operator:	Lowe
Truck No.:	KingVac VK-32
Vacuum Pump Type:	Liquid Ring
Tank Capacity:	2,866
Stack I.D. (inches):	3.8
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	10	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	14	10

Recovery/Disposal Information

Total Gal. of Liquid:	1,716
Disposal Facility:	*
Manifest No.:	*
Total Lbs. of Carbon (Offgas):	1,404
Cum. Lbs. Carbon Removed:	5,975
Lbs. Hydrocarbons Removed:	1,839
Cum. Lbs. Hydrocarbons:	8,336
Equiv. Gal. Removed:	304
Cum. Equiv. Gal. Removed:	1,375

ECOVAC SERVICES

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

EFR® EVENT GAUGING DATA

Client: BAT Env.	Facility Name: NEX (Navy Exchange) Auto Part/Fuel Lock	Facility ID#: 0-791718	Event #: 5
Facility Address: 757 Old Navy Road, Millington, Tennessee		Technician: Lewis	Date: 3/15/99

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		-	4.10	0.00	-	10.00	0.00	-5.90
MEM-2	4		-	3.36	0.00	-	9.90	0.00	-6.54
MEM-3	4		-	4.00	0.00	-	9.60	0.00	-5.60
MEM-6	4		-	3.27	0.00	-	10.20	0.00	-6.93
MEM-7	4		-	3.95	0.00	-	9.70	0.00	-5.75
MEM-8	4		-	4.90	0.00	-	10.10	0.00	-5.20
MEM-11	4		-	4.68	0.00	-	5.35	0.00	-0.45
MEM-12	4		-	4.20	0.00	-	11.20	0.00	-6.52
MEM-13	4		-	3.97	0.00	-	10.90	0.00	-6.70
MEM-14	6		-	3.97	0.00	-	10.10	0.00	-6.13
MEM-16	6		-	3.40	0.00	-	3.67	0.00	0.30
B-3	4		-	3.08	0.00	-	9.60	0.00	-5.63
B-4	4		-	3.70	0.00	-	3.94	0.00	-0.86

ECOVAC SERVICES

Comments:

Differential Pressure and Groundwater Drawdown Data Recorded During EFR®
Event No. 5 (March 15, 1999)
NEX (Navy Exchange) Auto Part/Fuel Lock
757 Old Navy Road
Millington, Tennessee

DIFFERENTIAL PRESSURE DATA

		Well Designation:				
		MEM-12	MEM-3	B-4	MEM-6	MEM-16
Nearest Extraction Well:		MEM-14	MEM-14	B-3	MEM-2	B-3
(Approx. Distance):		(9 feet)	(50 feet)	(54 feet)	(75 feet)	(75 feet)
Time	Elapsed Time	Differential Pressure Readings (inches of water):				
8:30	0.5 hr.	0.00	0.00	-	-0.07	-
9:00	1.0 hr.	-0.02	0.00	-	-0.03	-
9:30	1.5 hrs.	0.00	0.00	-	-0.04	-
10:00	2.0 hrs.	-0.01	0.00	-	-0.43	-
12:00	4.0 hrs.	-	-	-	-0.40	-
13:00	5.0 hrs.	-	-	-	-0.61	-
14:00	6.0 hrs.	-	-	-0.45	-	0.00
15:00	7.0 hrs.	-	-	-0.01	-	0.00
Maximum Change:		-0.02	0.00	-0.45	-0.61	0.00

GROUNDWATER DRAWDOWN DATA

		Well Designation:		
		MEM-11	B-4	MEM-16
Nearest Extraction Well:		MEM-8	B-3	B-3
(Approx. Distance):		(37 feet)	(54 feet)	(75 feet)
Time	Elapsed Time	Depth to Liquid (feet below top of casing):		
Prior to EFR®		4.68	3.70	3.40
13:30	8.0 hrs.	5.35	3.94	3.67
Maximum Change:		-0.67	-0.24	-0.27