

**2006 ANNUAL SUMMARY REPORT**

Stamina Mills
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**STAMINA MILLS SUPERFUND SITE
NORTH SMITHFIELD, RHODE ISLAND**

**Re: USEPA Docket No. I-91-1070
Revision: 0**

Prepared for:



**Kayser-Roth Corporation
102 Corporate Center Boulevard
Greensboro, North Carolina**

Prepared by:



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May 4, 2007

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1.0 INTRODUCTION

This *2006 Annual Summary Report* summarizes performance of remediation systems in soil and groundwater at the Stamina Mills Superfund Site (the Site) in North Smithfield, Rhode Island. This report has been prepared by EnSafe Inc. on behalf of Kayser-Roth Corporation for the United States Environmental Protection Agency (USEPA) and the Rhode Island Department of Environmental Management (RIDEM) in accordance with the 1990 *Record of Decision* (ROD) (USEPA, 1990) and as documented in the *Remedial Action Report — Soil and Groundwater Remedy* (EnSafe, 2001a). This report is based on quarterly reports prepared by EnSafe and submitted to the USEPA during 2006.

During 2006, operations at the Stamina Mills Superfund Site continued according to the modifications recommended in the *2002 Annual Report* (EnSafe, 2003). Site activities included:

- Vapor screening and groundwater sampling in selected soil vapor extraction (SVE) and multiphase extraction (MPE) wells to assess source area conditions and optimize remedial system operations.
- Operating the modified MPE system in saturated saprolite to focus on highly contaminated saprolite zones.
- Shutdown of MPE and winterization of the groundwater treatment system (GWTS).
- Quarterly groundwater extraction (GWE) and GWTS sampling.
- Semiannual vapor sampling at the vapor treatment system (VTS).
- Routine operations and maintenance.

Analytical data, validation reports, and monthly operations summary tables for the 2006 operating period are presented in the following documents:

- *Technical Memorandum — First Quarter 2006 Operations and Analytical Summary* (EnSafe, May 2006d)
- *Technical Memorandum — Second Quarter 2006 Operations and Analytical Summary* (EnSafe, August 2006e)

- *Technical Memorandum — Third Quarter 2006 Operations and Analytical Summary*
(EnSafe, December 2006f)

- *Technical Memorandum — Fourth Quarter 2006 Operations and Analytical Summary*
(EnSafe, May 2007b)

2.0 SVE AND MPE SYSTEM PERFORMANCE

As presented in technical memoranda that were submitted to USEPA, vapor extraction activities focused on mass removal from the seasonally saturated saprolite overlying bedrock.

2.1 SVE Shutdown

As recommended in the *2002 Annual Report*, the SVE system was not operated during 2006 due to extremely low vapor concentrations measured at individual SVE wellheads and the absence of significant rebound following winter shutdown periods. At the USEPA's request, vapor monitoring of SVE wellheads was integrated into routine operations and is summarized in Section 2.4.

2.2 MPE Improvements

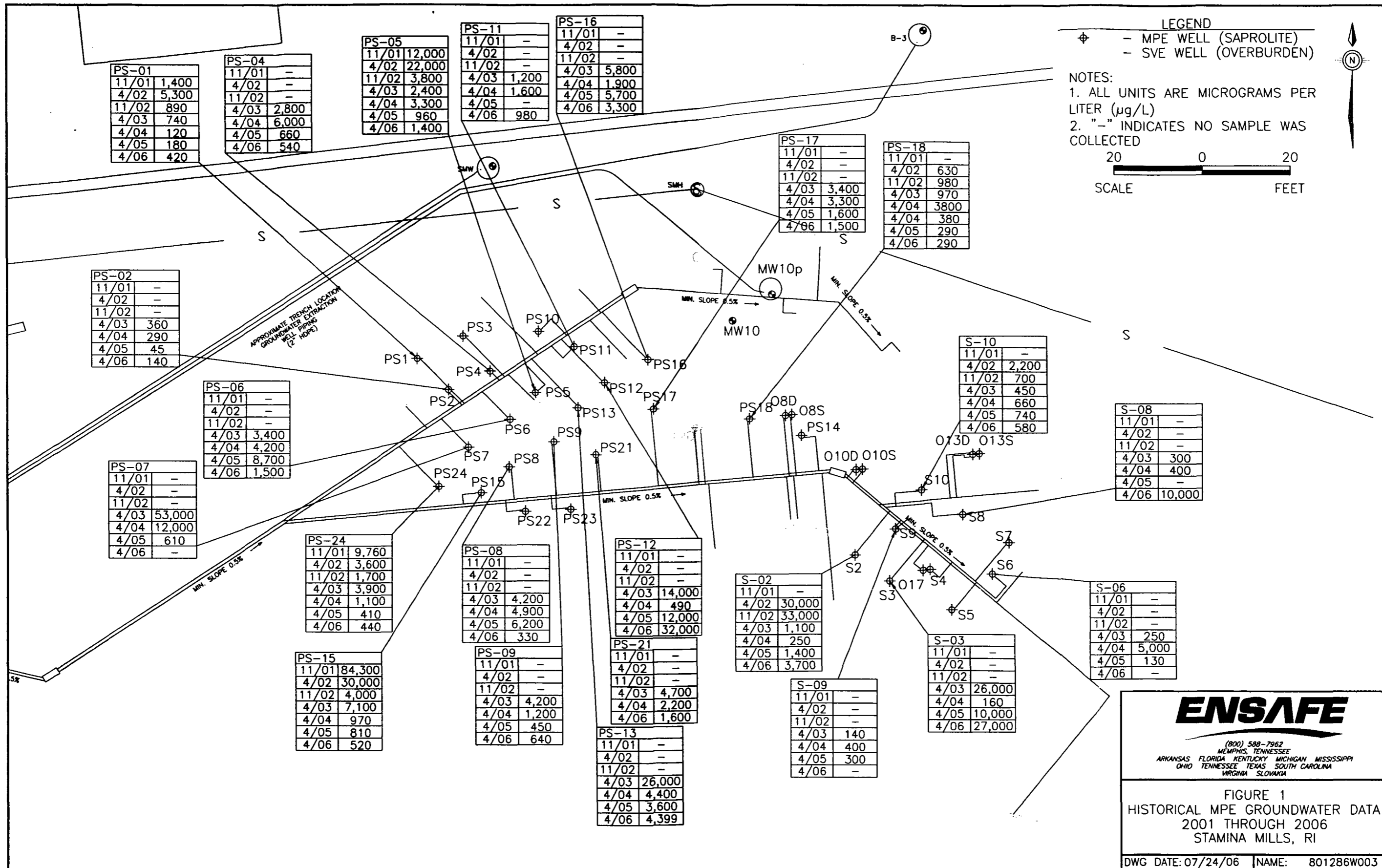
Vapor and groundwater analyses described in the *2002 Annual Report* suggested that significant residual trichloroethylene (TCE) mass remained in the saprolite and shallow groundwater zones (approximately 25 feet below ground surface [bgs]) at the site. Groundwater sampling performed in 2006 identified the following MPE wells as exhibiting the highest TCE concentrations (typically greater than 5,000 micrograms per liter [$\mu\text{g/L}$] total volatile organic compounds [VOCs]):

PS-12	PS-17	PS-21	S-02	S-08
PS-13	PS-18	PS-24	S-03	S-10
PS-16	PS-21			

These wells were selected for operation during 2006. Historical groundwater concentrations for the MPE wells are shown in Figure 1. Details regarding system startup are shown in a technical memorandum describing second quarter operations.

2.3 MPE Operations

The MPE system operated continuously following its startup on May 4, 2006, through shutdown on November 8, 2006. The few exceptions were the GWTS alarm conditions when extracted groundwater could not be treated and as noted in Table 2-1.



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**FIGURE 1
 HISTORICAL MPE GROUNDWATER DATA
 2001 THROUGH 2006
 STAMINA MILLS, RI**

DWG DATE: 07/24/06 NAME: 801286W003

Table 2-1
MPE System Monthly Hours Operational (Hours)

Month	Maximum Hours Possible	Total Hours Operational	Percent Operational	Notes
May	744	696	94%	Series of unknown alarms. An electrician was called onsite to troubleshoot, and the system was restarted. No cause was identified.
June	720	708	98%	HT-301 high level and T-600 high-level alarms. Performed system troubleshooting and restarted system
July	744	722	97%	HT-301 low flow and T-600 high-level alarms. Performed system troubleshooting and restarted system.
August	744	703.5	95%	HT-301 low level and T-600 high-level alarms. Performed system troubleshooting and restarted system.
September	720	477	66%	Repeated HT-301 low-level alarms resulting in intermittent operation 9/18/06 through 9/29/06. Reprogrammed variable speed drive.
October	744	744	100%	No alarm calls.
November	192	180	93%	HT-301 high-level alarm. Performed system troubleshooting and restarted system. MPE system shut down and converted to winter operations.
Total for 2006	4,608	4,032	88%	

Note:

MPE — Multi-Phase Extraction

Total running hours for the system were 4,032 out of a possible 4,608 hours (88% operational from May through November). The modified MPE system yielded 163,808 gallons of water during its operational period.

2.4 SVE/MPE Vapor Monitoring

As noted in Section 2.1, the USEPA requested periodic monitoring of vapor concentrations in all vadose zone wells to gauge changes over time. Vapor in MPE wells was sampled only once during 2006 in addition to the startup sampling.

As shown in Table 2-2, data are consistent with previous events, and vadose zone vapor concentrations during 2006 remained below the 44 parts per million volume (ppmv)

Table 2-2
 Vapor Concentration in Vadose Zone Wells

Well ID	Screen Interval (ft bgs)	Well Type	03/2006		06/2006		08/2006		11/2006	
			VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)
O-1	2-13	SVE	0.8	0.4	1.2	0.6	1.4	0.7	<5	<3
O-2	2-17	SVE	0.5	0.25	1.5	0.75	2.2	1.1	<5	<3
O-3D	11.5-17	SVE	0.8	0.4	1.3	0.65	0	0	<5	<3
O3-S	2-9	SVE	0	0	0	0	0.1	0.05	<5	<3
O-5	2-14	SVE	0.3	0.15	0.6	0.3	7.4	3.7	<5	<3
O-6	2.5-13.5	SVE	0.5	0.25	0.5	0.25	2.7	1.35	<5	<3
O-7	2.5-15	SVE	0.3	0.15	0.7	0.35	1.2	0.6	<5	<3
O-8S	2-9	SVE	0.1	0.05	0.6	0.3	1.2	0.6	<5	<3
O-8D	11-18	SVE	4.2	2.1	1.5	0.75	0.9	0.45	5	3
O-9	2-14.5	SVE	2.2	1.1	3.6	1.8	4	2	5	3
O-10S	2.5-8.5	SVE	0.5	0.25	4.1	2.05	16	8	<5	<3
O-10D	10.5-16	SVE	24.1	12.05	0.4	0.2	9.6	4.8	<5	<3
O-12	7.5-18	SVE	6.6	3.3	5.5	2.75	12.6	6.3	10	5
O-13S	3-9	SVE	1	0.5	2.1	1.05	1.7	0.85	5	3
O-13D	11-16	SVE	13.7	6.85	0.4	0.2	7.3	3.65	75.4	38
O-14	2-12	SVE	0.3	0.15	0.5	0.25	0.7	0.35	<5	<3
O-17	2-7.5	SVE	0	0	4.3	2.15	0.2	0.1	<5	<3
O-18	2-10	SVE	0.1	0.05	0.8	0.4	0.5	0.25	<5	<3
O-19D	11-20	SVE	1.5	0.75	0.6	0.3	0	0	<5	<3
O-19S	3-9	SVE	0.5	0.25	0.4	0.2	0	0	<5	<3
P-O1	2-12	SVE	1	0.5	3.2	1.6	4.8	2.4	<5	<3

Table 2-2
Vapor Concentration in Vadose Zone Wells

Well ID	Screen Interval (ft bgs)	Well Type	03/2006		06/2006		08/2006		11/2006	
			VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)	VOCs[1] (ppmv)	Estimated TCE Conc.[2] (ppmv)
P-04	2-8	SVE	1.7	0.85	4.5	2.25	2.5	1.25	10	5
P-05	2-13	SVE	3.7	1.85	4.8	2.4	2.1	1.05	5	3
P-06	11.5-16	SVE	11.6	5.8	18.6	9.3	3.6	1.8	25.1	13
P-08	9.5-14	SVE	8.7	4.35	7	3.5	3	1.5	10	5

Notes:

- [1] — Volatile organic compound (VOC) concentrations are direct readings from photoionization detector (PID).
- [2] — Reported concentration divided by two is approximate concentration as TCE
- ND — Not detected
- <1 — Detection on PID but not high enough to register whole number on display
- NM — Not measured
- ft bgs — Feet below ground surface
- ppmv — Parts per million volume

TCE criterion established in the *Annual Summary Report — 2001* (Envirogen, 2002) (with maximum vapor concentrations less than 10 ppmv as TCE). These data suggest that little to no rebound occurred during the operating period. Given how little rebound is noted in SVE wells, and that vapor concentrations are consistently less than 44 ppmv, EnSafe recommends reducing sampling frequencies for SVE wellheads to March/April and September/October to reflect pre-MPE and post-MPE season conditions.

3.0 GWE/GWTS SYSTEM PERFORMANCE

The GWE system was started in May 2000 and has remained operational since then. Groundwater sampling data and associated data validation reports may be found in the technical memoranda submitted for 2006.

3.1 GWE Operations

The three GWE wells operated continuously throughout 2006 except during GWTS alarm conditions noted in Table 3-1. During this period, no prolonged shutdowns occurred; the system operated 96% of the time during 2006, averaging less than two alarm conditions per month.

**Table 3-1
 GWE Monthly Hours Operational — 2006 (Hours)**

Month	Maximum Hours Possible	SMW	B-3	MW-10	Number of GWTS Alarm Conditions	Comments
January	744	744	744	744	0	None
February	672	672	672	672	0	None
March	744	744	744	744	0	None
April	720	720	720	720	0	None
May	744	696	696	696	2	Series of unknown alarms. An electrician was called onsite to troubleshoot, and the system was restarted. No cause was identified.
June	720	708	708	708	1	HT-301 high level and T-600 high-level alarms. Performed system troubleshooting and restarted system
July	744	722	722	722	4	HT-301 low flow and T-600 high-level alarms. Performed system troubleshooting and restarted system.
August	744	703.5	703.5	703.5	3	HT-301 low level and T-600 high-level alarms. Performed system troubleshooting and restarted system.
September	720	476.75	476.75	476.75	7	Repeated HT-301 low-level alarms resulting in intermittent operation 9/18/06 through 9/29/06. Reprogrammed variable speed drive.
October	744	744	744	744	0	None

**Table 3-1
 GWE Monthly Hours Operational — 2006 (Hours)**

Month	Maximum Hours Possible	SMW	B-3	MW-10	Number of GWTS Alarm Conditions	Comments
November	720	720	720	720	1	HT-301 high level alarm call was corrected and system restarted. MPE system shut down and converted to winter operations.
December	744	744	744	744	0	None
2006 Total	8,760	8,394.25 96%	8,394.25 96%	8,394.25 96%	18	

Notes:

- GWE — Groundwater extraction
- GWTS — Groundwater treatment system
- SMW — Stamina Mills Well
- HT — Holding Tank

Flow rates from the GWE are shown in Table 3-2 for 2005 and 2006. Approximately 5.3 million gallons were removed from the GWE and MPE systems during 2006, with MW-10 contributing the majority of the flow. Comparative flow data since operations started in 1999 are shown in Table 3-3.

**Table 3-2
 Cumulative GWE/GWTS Volumes (Gallons)**

	SMW	B-3	MW-10	MPE-AQ	GWTS Total
January-05	210,971	157,490	247,388	0	615,849
February-05	196,453	128,792	222,171	0	547,416
March-05	154,100	133,007	225,297	0	512,404
April-05	218,054	139,382	239,941	0	597,377
May-05	180,403	133,821	228,672	29,051	571,947
June-05	113,449	114,541	183,364	20,727	432,081
July-05	87,769	110,907	111,504	20,175	330,355
August-05	74,143	101,208	101,007	237	276,595
September-05	110,243	120,130	70,000	99	300,472
October-05	0	0	0	0	0
November-05	0	0	0	0	0
December-05	170,973	131,023	212,785	0	514,781
Total 2005	1,516,558	1,270,301	1,842,129	70,289	4,699,277

Table 3-2
Cumulative GWE/GWTS Volumes (Gallons)

	SMW	B-3	MW-10	MPE-AQ	GWTS Total
January-06	215,396	150,409	246,704	0	612,509
February-06	186,081	133,139	221,161	0	540,381
March-06	122,143	143,246	201,104	0	466,493
April-06	108,875	172,937	142,673	0	424,485
May-06	167,041	150,348	176,847	24,122	518,358
June-06	124,623	140,223	197,811	54,619	517,276
July-06	153,243	120,247	203,319	35,356	512,165
August-06	110,021	122,067	150,976	6,028	389,092
September-06	49,647	88,356	102,351	21,708	262,062
October-06	102,935	134,261	124,024	18,245	379,465
November-06	72,988	58,980	79,043	3,730	214,741
December-06	162,197	150,508	172,938	0	485,643
Total 2006	1,577,190	1,564,721	2,018,951	163,808	5,324,671

Notes:

SMW — Stamina Mills Well
 GWE — Groundwater extraction system
 GWTS — Groundwater treatment system
 MPE-AQ — Multiphase extraction — aqueous phase
 All volumes obtained from 2006 technical memoranda.

Table 3-3
Comparative Flow Data — 1999 through 2006 (Million Gallons)

Year	SMW	B-3	MW-10	MPE-AQ	Total
1999	—	—	—	0.48	0.48
2000	0.63	1.28	0.4	0.3	2.61
2001	1.15	2.1	1.36	0.75	5.36
2002	1.41	1.77	0.9	0.28	4.36
2003	1.24	1.52	1.91	0.21	4.88
2004	1.49	1.59	1.89	0.27	5.24
2005	1.52	1.27	1.84	0.07	4.7
2006	1.58	1.56	2.02	0.16	5.32
Total To Date	9.02	11.09	10.32	2.04	32.95

Notes:

SMW — Stamina Mills Well
 MPE-AQ — Multiphase extraction — aqueous phase

3.2 GWTS Operations

Mass removal rates in the GWTS are shown in Table 3-4 and are compared with prior years' data in Table 3-5. MW-10 and B-3 contributed approximately 88% of aqueous phase mass. The Stamina Mills Well (SMW) contributes minimal mass into the system (roughly 12%), while providing approximately 32% of the total system flow, a trend consistent with previous years.

As noted in 2003, aqueous phase samples from the MPE are expected to underestimate mass removal from the saprolite because much of the contamination is expected to strip into the vapor phase within the MPE manifold. MPE removal rates, therefore, are best represented by incremental differences between the estimated GWTS mass loading and the total VTS influent loading, as shown in Table 3-6¹. MPE vapor concentrations represent mass removed in the vapor phase as well as that stripped from the aqueous phase. The MPE system contributed 32% of the total TCE removed during the 2006 operating season, with a total removal of approximately 62 pounds for the year. Maximum mass removal through the MPE system occurred in August, September, and October, which coincides with minimum water levels in saprolite wells and lowest flow rates from GWE wells.

**Table 3-4
 Mass Removal Summary**

	SMW	B-3	MW-10	MPE
First Quarter 2006				
Total Flow (gallons)	523,620	426,794	668,969	
Influent Concentration (µg/L)	710	3,700	1,700	NA
Mass Removed (pounds)	3.07	13.03	9.38	
Second Quarter 2006				
Total Flow (gallons)	400,539	463,508	517,331	78,741
Influent Concentration (µg/L)	180	1,500	240	46
Mass Removed (pounds)	0.59	5.74	1.02	0.03
Third Quarter 2006				
Total Flow (gallons)	312,911	330,670	456,646	63,092
Influent Concentration (µg/L)	660	2,900	4,600	46
Mass Removed (pounds)	1.70	7.91	17.33	0.02
Fourth Quarter 2006				
Total Flow (gallons)	338,120	343,749	376,005	21,975
Influent Concentration (µg/L)	85	3,600	150	46
Mass Removed (pounds)	0.24	10.20	0.47	0.01
Total Mass Removed — 2006	5.60	36.88	28.20	0.06

¹ Differences are noted in mass estimates calculated using vapor- and aqueous-phase calculations, as shown in Tables 3-4 and 3-6. This difference is attributable to the quarterly frequency of aqueous-phase sampling events and subsequent extrapolation. Vapor-phase data are calculated based on more frequent sampling using a PID. Both estimates typically agree within 20%.

Notes:

- SMW — Stamina Mills Well
- MPE — Multi-Phase Extraction System
- µg/L — micrograms per liter

Mass removal rates shown above are calculated based on quarterly influent concentrations and flow rates. These mass removal rates may differ from those shown in Table 3-6, which are based on vapor concentrations measured with a photoionization detector (PID).

Flow rates were calculated using estimated flow data from SMW, B-3, MW-10, and MPE wells.

Table 3-5
Comparative Mass Removal from Groundwater — 1998 through 2006 (lbs TCE)

Year	SMW	B-3	MW-10	MPE-GW	Total
1998	—	—	—	110	110
1999	—	—	—	382	382
2000	5	97	156	213	471
2001	15	79	143	97	333
2002	24	42	158	37	261
2003	6	41	69	10	126
2004	6	35	106	0	148
2005	9	35	29	0	73
2006	6	37	28	0	71
Total To Date	71	366	689	849	1,975

Notes:

- SMW — Stamina Mills Well
- MPE — Multiphase extraction system
- TCE — Trichloroethylene
- lbs — Pounds

These mass removal rates may differ from those shown in Table 3-6, which are based on vapor concentrations measured with a photoionization detector (PID).

Table 3-6
Mass Contributions — GWTS and MPE Vapor System

Month	GWTS — Vapor (lbs)	MPE Vapor (lbs)	VTS — Influent (lbs)	% MPE Contribution
January-05	10.2	0	10.2	0%
February-05	10	0	10	0%
March-05	6.6	0	6.6	0%
April-05	4	0	4	0%
May-05	3.9	3.1	7.1	44%
June-05	7.7	6.3	14	45%
July-05	16	1.7	17.7	10%
August-05	17.8	1.8	19.6	9%
September-05	19.6	0	19.6	0%
October-05	0	0	0	0%
November-05	0	0	0	0%
December-05	4.9	0	4.9	0%
2005 Totals	100.7	12.9	113.6	11%

Table 3-6
Mass Contributions — GWTS and MPE Vapor System

Month	GWTS — Vapor (lbs)	MPE Vapor (lbs)	VTS — Influent (lbs)	% MPE Contribution
January-06	2.4	0	2.4	0%
February-06	3.1	0	3.1	0%
March-06	11.5	0	11.5	0%
April-06	10.4	0	10.4	0%
May-06	15.0	1.8	16.8	11%
June-06	4.5	0.9	5.4	17%
July-06	7.5	1.7	9.3	18%
August-06	20.9	19.8	40.7	49%
September-06	13.1	13.7	26.8	51%
October-06	21.9	22.6	44.4	51%
November-06	17.0	2.3	19.3	12%
December-06	9.8	0	9.8	0%
2006 Totals	137.1	62.8	199.9	32%

Notes:

GWTS — Groundwater treatment system

MPE — Multiphase extraction system

VTS — Vapor treatment system

lbs — pounds

Vapor-phase mass contributions are estimated using photoionization detector (PID) readings.

MPE vapor represents contaminants from both the vapor and aqueous phase.

GWTS influent and effluent data, as submitted to the Woonsocket publicly owned treatment works (POTW), are summarized in Table 3-7; 2005 data are provided for comparison. As discussed in quarterly memoranda, GWTS influent data are now collected quarterly while effluent data are collected monthly to comply with the sewer discharge agreement. Analytical data from 2006 indicate that treated groundwater meets the Woonsocket POTW's discharge requirements.

Table 3-7
GWTS Influent and Effluent Concentrations (µg/L)

Date	Influent (WSP-304)			Effluent (WSP-601)		
	TCE	Cis-1,2-DCE	Vinyl Chloride	TCE	Cis-1,2-DCE	Vinyl Chloride
1/3/2005	NS	NS	NS	5 U	5 U	5 U
2/7/2005	NS	NS	NS	1 JB	5 U	5 U
3/7/2005	1,900 D	160 D	2 J	5 U	5 U	5 U
4/4/2005	NS	NS	NS	2 JB	5 U	5 U
5/2/2005	NS	NS	NS	5 U	5 U	5 U
6/6/2005	NS	NS	NS	5 U	5 U	5 U
7/5/2005	NS	NS	NS	5 U	5 U	5 U
8/1/2005	NS	NS	NS	5 U	5 U	5 U

Table 3-7
GWTS Influent and Effluent Concentrations (µg/L)

Date	Influent (WSP-304)			Effluent (WSP-601)		
	TCE	Cis-1,2-DCE	Vinyl Chloride	TCE	Cis-1,2-DCE	Vinyl Chloride
9/6/2005	NS	NS	NS	5 U	5 U	5 U
10/3/2005	NS	NS	NS	600	29	25 U
11/21/2005	2,200 D	300 D	1 J	NS	NS	NS
12/19/2005	650	58	25 U	5 U	5 U	5 U
1/3/2006	NS	NS	NS	5 U	5 U	5 U
2/13/2006	NS	NS	NS	5 U	5 U	5 U
3/13/2006	1,800	200	25 U	1	5.0 U	5.0 U
4/29/2006	NS	NS	NS	2.2 J	5 U	5 U
5/8/2006	NS	NS	NS	5 U	5 U	5 U
6/5/2006	340 D	48	5 U	5 U	5 U	5 U
7/3/2006	NS	NS	NS	5 U	5 U	5 U
8/14/2006	NS	NS	NS	5 U	5 U	5 U
9/11/2006	3,200 D	190	1.5 J	5 U	5 U	5 U
10/6/2006	NS	NS	NS	10 U	10 U	10 U
11/7/2006	NS	NS	NS	5 U	5 U	5 U
12/4/2006	1,200	19 J	50 U	5 U	5 U	5 U

Notes:

All units in micrograms per liter (µg/L).

- U — Contaminant was not detected above the contract required reporting limit as shown.
- J — Concentration was estimated
- D — Concentration was obtained from a diluted sample because the initial analysis exceeded the calibration range of the analyzer.
- JB — Analyte detected below quantization limits and detected in the associated method blank.
- NS — No sample taken
- TCE — Trichloroethylene
- Cis-1,2-DCE — Cis-1,2-Dichloroethylene
- GWTS — Groundwater Treatment System

3.3 Phase III Groundwater Monitoring

As discussed in the *Phase III Groundwater Monitoring Work Plan (Revision 1)* (EnSafe, October 2001b), Phase III groundwater monitoring was designed to evaluate decreases in concentration of TCE, resulting from implementation of the groundwater remediation system.

Onsite wells MW-2, MW-10, and the SMW will be monitored once every nine months throughout the duration of the Phase III groundwater monitoring program. Offsite wells will be monitored in stages. Wells north and west of the site (I-12, I-37, and A-175) as well as MW-17, south of the site, are included in the current monitoring program (Stage 1). Contaminant trends in these wells will be monitored until concentrations are less than the ROD-prescribed cleanup standards. Once concentrations in these outer wells meet the ROD goals, Stage 2 wells closer to the compliance boundary (I-7, I-20, I-24, I-28, and I-31) will be monitored to assess remediation of TCE-affected groundwater.

RIDEM concerns raised in 2005 regarding discharge of purge water from low-flow sampling to the adjacent Branch River resulted in recommendations to change sampling methods. Following discussions with USEPA and RIDEM regarding alternative sampling techniques, a passive diffusion bag (PDB) sampling event was performed in July 2006 to assess the viability of the technique in offsite, inactive residential wells. Concerns regarding release of artesian purge water to the Branch River from MW-17 precluded sampling from this well. In addition, both low-flow purge samples and PDB samples were collected from onsite well MW-2.

Results from the July 2006 event are discussed in the *Passive Diffusion Bag Sampling Event — July 2006 Report* (EnSafe, May 2007a). In general, the sampling event found:

- PDB results were very comparable to data collected historically using low-flow methods.
- PDB results were comparable to low-flow data collected in July 2006 from MW-2.
- Little vertical stratification was observed when samples from different depth intervals were compared, suggesting a well-mixed water column in offsite, inactive residential wells.

Summary results are presented in Tables 3-8 through 3-10 for PDB samples, purged samples, and treatment system samples, respectively.

**Table 3-8
 Phase III Sampling Results vs. PDB Sampling Results**

		Mar-02	Dec-02	Sep-03	Jun-04	July 2006 PDB Sampler Range
I-12	Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5
	Cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
	Trichloroethene	3	3.1	10	2.3	0.75-1.6

Table 3-8
Phase III Sampling Results vs. PDB Sampling Results

	Mar-02	Dec-02	Sep-03	Jun-04	July 2006 PDB Sampler Range
I-37					
Vinyl Chloride	<0.5	<10	<0.5	<0.5	<0.5
Cis-1,2-Dichloroethene	<0.5	<10	<0.5	0.46	0.36-0.42
Trichloroethene	28	15	4.7	14	7.6-8.3
MW-2					
Vinyl Chloride	<4,000	130	200	<400	120-160 *
Cis-1,2-Dichloroethene	6,100	5,500	6,100	1,900	970-4,400 *
Trichloroethene	60,000	27,000	170,000	15,000	11,000-15,000 *

Notes:

All units are micrograms per liter (µg/L).

Ft BTOC — Feet below top of casing

*Indicates that the 15- to 17-foot bgs sample was omitted from the evaluation due to concerns regarding sampler submergence.

Table 3-9
Phase III Sampling — A-175 and MW-2 Purge Sample

	Mar-02	Dec-02	Sep-03	Jun-04	Jul-06
A-175					
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5
Cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	nd	<0.5	<0.5	<0.5	<0.5
MW-2					
Vinyl Chloride	<4,000	130	200	<400	130
Cis-1,2-Dichloroethene	6,100	5,500	6,100	1,900	6,400
Trichloroethene	60,000	27,000	170,000	15,000	21,000

Note:

All units are micrograms per liter (µg/L).

Table 3-10
Phase III Sampling Onsite Extraction Wells

	Mar-02	Dec-02	Sep-03	Jun-04	Jul-06
SMW					
Vinyl Chloride	<200	<10	<10	<10	<10
Cis-1,2-Dichloroethene	72	42	13	4	31
Trichloroethene	3,100	2,500	4,300	600	1,100
MW-10					
Vinyl Chloride	<1,000	11	<10	6	<10
Cis-1,2-Dichloroethene	2,900	1700	11	150	380
Trichloroethene	14,000	15,000	790	6,400	1,200

Table 3-10
Phase III Sampling Onsite Extraction Wells

	Mar-02	Dec-02	Sep-03	Jun-04	Jul-06
B-3					
Vinyl Chloride	<400	<10	<0.5	<10	<10
Cis-1,2-Dichloroethene	<400	42	8.3	40	31
Trichloroethene	4,900	3,600	1,100	4,000	5,100

Note:

All units are micrograms per liter ($\mu\text{g/L}$).

The report recommended continued use of the PDB sampling approach in offsite wells. A revised *Phase III Groundwater Sampling Work Plan* is currently being developed to document modifications to field methodology.

4.0 VTS PERFORMANCE

The VTS operated in parallel with the GWTS in 2006. Influent and effluent concentrations from semiannual monitoring are shown in Table 4-1.

Table 4-1
VTS Influent and Effluent Concentrations (ppbv)

Date	Influent (VSP-701)			Effluent (VSP-703)		
	TCE	Cis-1,2-DCE	Vinyl Chloride	TCE	Cis-1,2-DCE	Vinyl Chloride
6/21/2004	5,200	820	9.6 J	7	1 U	16
12/20/2004	2,900	470	9.5	79	310	5.2
9/19/2005	2,100J	730J	29 J	2.2	3.8	0.87
12/19/2005	710	88	3.1 J	29	2.8	3.5
6/16/2006	300	31	0.77 J	14	ND	0.88 J
12/18/2006	2,600	160	7.7 J	ND	ND	2.8

Notes:

- VTS — Vapor treatment system
 - TCE — Trichloroethylene
 - Cis-1,2-DCE — Cis-1,2-Dichloroethylene
 - U — Contaminant was not detected above the contract required reporting limit as shown.
 - J — Concentration was estimated
 - ND — Contaminant was not detected
- All units in parts per billion volume (ppbv).

Emissions rates for TCE, cis-1,2-dichloroethylene, and vinyl chloride in VTS effluent are well below mass limitation standards established in RIDEM Air Pollution Regulation No. 9, as shown in Table 4-2.

Table 4-2
Air Emissions Compliance Data

Contaminant Regulation No. 9 Mass Limitation	TCE		Cis-1,2-DCE		Vinyl Chloride		
	Flow Rate	Emission Rate	Flow Rate	Emission Rate	Flow Rate	Emission Rate	
	(cfm)	(lb/hr)	(cfm)	(lb/hr)	(cfm)	(lb/hr)	
	Concentration (ppbv)	Concentration (ppbv)	Concentration (ppbv)	Concentration (ppbv)	Concentration (ppbv)	Concentration (ppbv)	
		2.28 lb/hr		0.02 lb/hr		2.28 lb/hr	
Date	Flow Rate (cfm)	Concentration (ppbv)	Emission Rate (lb/hr)	Concentration (ppbv)	Emission Rate (lb/hr)	Concentration (ppbv)	Emission Rate (lb/hr)
6/21/2004	428	7	2.87E-05	ND	0	16	0.000101632
12/20/2004	333	79	2.52E-04	310	2.07E-03	5.2	2.57E-05
9/14/2005	318	2.2	6.70E-06	3.8	2.42583E-05	0.87	4.11E-06
12/19/2005	320	29	8.88E-05	2.8	1.80E-05	3.5	1.66E-05

Table 4-2
Air Emissions Compliance Data

Contaminant Regulation No. 9 Mass Limitation	TCE		Cis-1,2-DCE		Vinyl Chloride		
	2.28 lb/hr		0.02 lb/hr		2.28 lb/hr		
Date	Flow Rate (cfm)	Concentration (ppbv)	Emission Rate (lb/hr)	Concentration (ppbv)	Emission Rate (lb/hr)	Concentration (ppbv)	Emission Rate (lb/hr)
6/16/2006	320	14	4.29E-05	ND	0	0.88 J	4.18E-06
12/18/2006	325	ND	0	ND	0	2.8	1.35E-05

Notes:

TCE — Trichloroethylene
 cis-1,2-DCE — cis-1,2-Dichloroethylene
 cfm — cubic feet per minute
 Concentrations are expressed in parts per billion volume (ppbv)
 Emissions rates are expressed in pounds per hour (lb/hr)

Emissions rates are calculated using the following equation:

$$\text{Concentration} \times \frac{1 \text{ ppm}}{1,000 \text{ ppb}} \times \frac{\text{APF}}{1 \text{ ppm}} \times Q_{\text{air}} \times \frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \times \frac{1 \text{ kg}}{1,000,000 \text{ mg}} \times \frac{2.2 \text{ lbs}}{1 \text{ kg}} \times \frac{60 \text{ m}}{1 \text{ hr}} = \text{Mass}$$

Where:

Concentration — ppb
 APF — air pollution factor, mg/m³
 Q_{air} — air flow rate, cfm
 Mass — lbs/hr
 APF_{TCE} — 2.56 mg/m³
 APF_{DCE} — 5.37 mg/m³
 APF_{VC} — 3.97 mg/m³

5.0 RECOMMENDATIONS FOR 2007 OPERATING SEASON

Based on 2006 operations data and the goals outlined in the *2002 Annual Report*, the following recommendations will be implemented at the Site during 2007:

- Continued shutdown of the SVE system, with vadose zone vapor monitoring in March/April and September/October 2007 only.
- Continued operation of the modified MPE system using drop tubes for groundwater and vapor extraction with final well selection based on MPE well vapor- and aqueous-phase sampling prior to system startup.
- Continued operation of the GWE system.
- Evaluation of flow and concentration of SMW contributions to the GWTS, to determine whether mass contributions and/or water table suppression from this well justifies continued operations.
- Continued sampling following protocols established in 2003:
 - Monthly monitoring of GWTS effluent for POTW discharge reporting.
 - Quarterly monitoring of GWE influent.
 - Semiannual monitoring of VTS influent and effluent.
- Continuance of Phase III groundwater sampling with modifications, including use of PDB samplers for offsite, inactive residential wells and elimination of MW-17 from the sampling program.

At this time, no substantial changes in operation are anticipated. Monthly reporting of operations and maintenance summary tables will continue, with quarterly submittal of analytical data in technical memoranda. Phase III monitoring data will be submitted under separate cover.

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