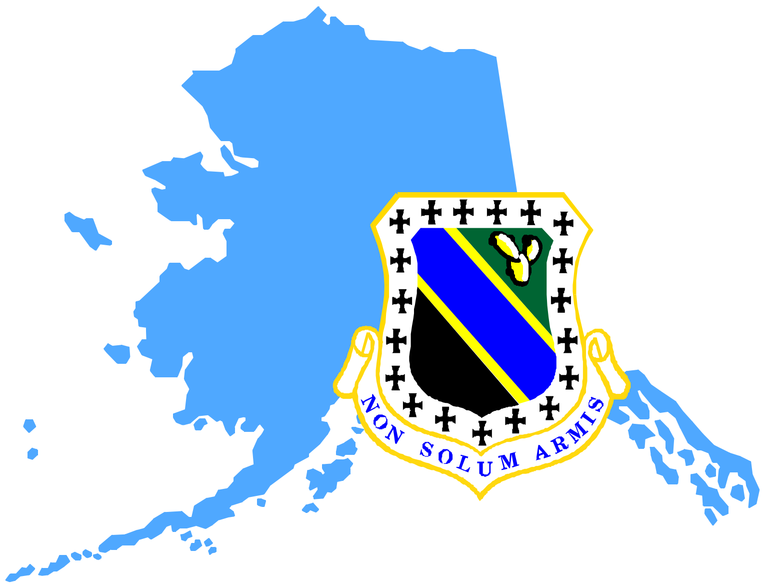

UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

2003 ANNUAL TECHNICAL REPORT
ENVIRONMENTAL MONITORING AND SYSTEM OPTIMIZATION OF SD15 HIGH VACUUM EXTRACTION SYSTEM
ELMENDORF AFB, ALASKA

FINAL

JULY 2004

ANNUAL TECHNICAL REPORT

Environmental Monitoring and System Optimization of SD15 High Vacuum Extraction System

Elmendorf AFB, Alaska

Prepared for:
3rd Civil Engineer Squadron/Environmental Restoration
and
Air Force Center for Environmental Excellence

Contract No. F41624-03-D-8622/TO 0010
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July 2004

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ACM	Alaska Cleanup Matrix
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AVO	aromatic volatile organic
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylene
COC	chemical of concern
DRO	diesel range organic
FFA	Federal Facilities Agreement
FY	fiscal year
GRO	gasoline range organic
HVE	high vacuum extraction
HVOC	halogenated volatile organic compound
ID	identification
MCL	maximum contaminant level
mrl	method reporting limit
µg/L	microgram per liter
mg/Kg	milligram per kilogram
mg/L	milligram per liter
NA	not analyzed
ND	not detected
NS	not sampled
O&M	operation and maintenance
OU	Operable Unit

ACRONYMS AND ABBREVIATIONS *(continued)*

O/W	oil/water
ppm	part per million
ppmv	part per million by volume
PVC	polyvinyl chloride
ROD	Record of Decision
scfm	standard cubic feet per minute
SVE	soil vapor extraction
TCE	trichloroethene
TPH	total petroleum hydrocarbon
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

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1.0 INTRODUCTION

This report has been prepared for the United States Air Force (USAF) under Air Force Center for Environmental Excellence (AFCEE) Contract No. F41624-03-D-8622, Task Order 10 to document the results of environmental monitoring and system optimization of the SD15 High-Vacuum Extraction (HVE) system from January 1, 2003 through December 31, 2003, at Operable Unit (OU) 6, Elmendorf Air Force Base (AFB), Alaska (Figure 1-1). The report is organized as follows:

- **Section 1** presents a general background of the SD15 HVE system, remediation goals, and project objectives;
- **Section 2** provides a protectiveness evaluation to assess whether the remedial action implemented for SD15 is protective of human health and the environment;
- **Section 3** provides a system performance evaluation;
- **Section 4** summarizes the maintenance and operation of the HVE system, and includes a summary of system shutdowns, maintenance tasks, system modifications, and out-year operation and maintenance (O&M) cost summary;
- **Section 5** provides conclusions and recommendations; and
- **Section 6** presents a list of references used in preparing this report.

1.1 BACKGROUND

Source SD15 is a former sludge disposal site located on the north side of Elmendorf AFB, just west of Talley Avenue, on what is known as Elmendorf Moraine. It consists of three 4- to 6-inch thick concrete pads, each measuring approximately 30 by 50 feet. The concrete pads were used from the early 1970s until 1983 to weather fuel filters and pads and to dispose of tank sludge. The primary sources of contamination at this site are identified as various spent petroleum products and solvents, which were stored in aboveground tanks, contained in filter elements, or otherwise released onto the concrete or open ground surface at SD15.

In 1997, the USAF issued a Record of Decision (ROD) for remedial corrective actions at OU 6 to ensure adequate protection of human health and the environment. Specific remedial action objectives to address groundwater and soil contamination at SD15 are as follows (USAF, 1997a):

- Prevent the domestic use of water (i.e., use resulting in ingestion and dermal contact of water, and inhalation of vapors) in the perched aquifer having benzene; ethylbenzene; toluene; 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane, 1,2-dichloroethane; and trichloroethene (TCE) in excess of maximum contaminant levels (MCL) and/or resulting in a cancer risk greater than 1.0E-06, or a Hazard Index greater than 1.0; and

- Prevent the possible migration of contaminants from soils having diesel range organics (DRO), gasoline range organics (GRO), and benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations exceeding Alaska Cleanup Matrix (ACM) Level D.

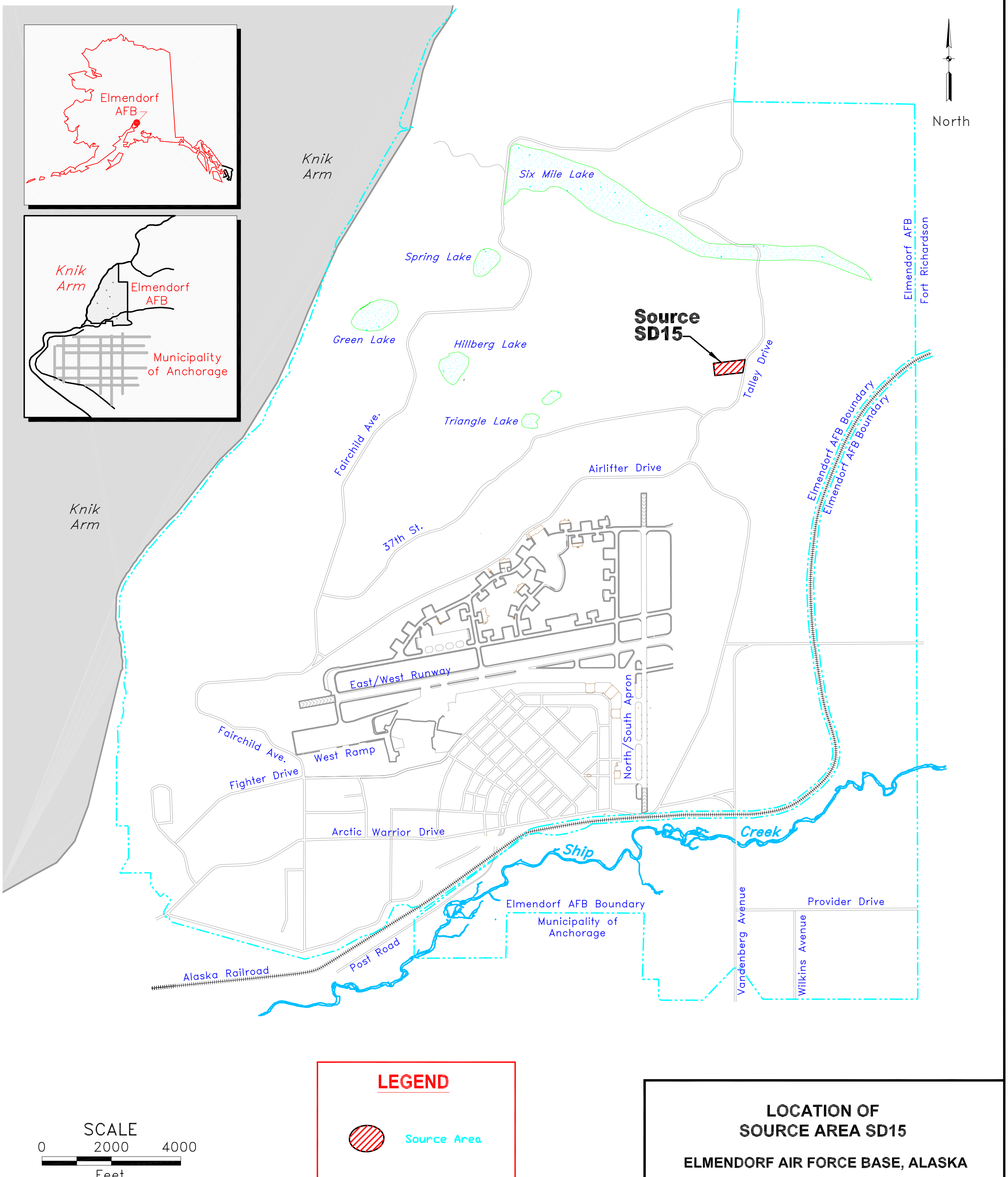
The remedy selected for SD15 and documented in the OU 6 ROD was HVE with institutional controls and long-term monitoring of groundwater in the perched aquifer and deep soils; and excavation, thermal treatment, and back-filling for shallow soils. Remediation of the deep aquifer was not required because groundwater contamination in the deep aquifer did not exceed regulatory or health levels.

A treatability study was initiated at SD15 in April 1996, and an HVE system was designed and constructed in the fall of 1996. The HVE system was activated in December 1996, and has been in operation since that time. The selected remedy for shallow soils was implemented in 1996. Approximately 170 cubic yards of fuel-contaminated soil were excavated from four areas, treated, and used to backfill the excavations. Confirmation samples indicated that two of the areas were below cleanup levels. The other two areas were incorporated into the HVE treatment. Four extraction wells were used to extract contaminated groundwater and soil vapors from two known areas of contamination at SD15. The SD15 HVE system was originally used to treat a third area of contamination; however, the soil vapor extraction (SVE) well at this location (W-1201 on Figure 1-2) was taken off-line because soil closure sampling conducted in 2000 showed completion of remediation efforts at this area (USAF, 2000). A more comprehensive discussion of SD15 remedy components is presented in Section 2.1. A complete description of the HVE system can be found in the *SD15 High-Vacuum Extraction System Operation and Maintenance Manual, Final* (USAF, 1997b).

Samples were collected from two known areas of shallow soil contamination sampled in 1999 and again in 2002 to satisfy requirements in the ROD that sampling of contaminated soil mediums be performed every three years to evaluate system performance and assess progress towards remediation. The results of this sampling indicated that COCs exceeding remediation goals persist in two areas - just south of the HVE Process Building and near HVE Well W-1303. The 2002 SD15 Annual Technical Report recommended SVE at these locations to complete the cleanup of these shallow soils. The system was modified in 2003 to deactivate two of the HVE wells (W-1303 and W-1304) and add 4 new Soil Vapor Extraction (SVE) wells. The present layout of the SD15 HVE system along with areas of soil and groundwater contamination is presented in Figure 1-2.

1.2 REMEDIATION GOALS

Attainment of remediation goals established in the OU 6 ROD can be used as justification for shutting down the HVE system and site closure. The remediation goals identified in the OU 6 ROD for SD15 are presented in Table 1-1 and consist of MCLs for groundwater and ACM Level D for soil contamination.



LOCATION OF SOURCE AREA SD15

ELMENDORF AIR FORCE BASE, ALASKA

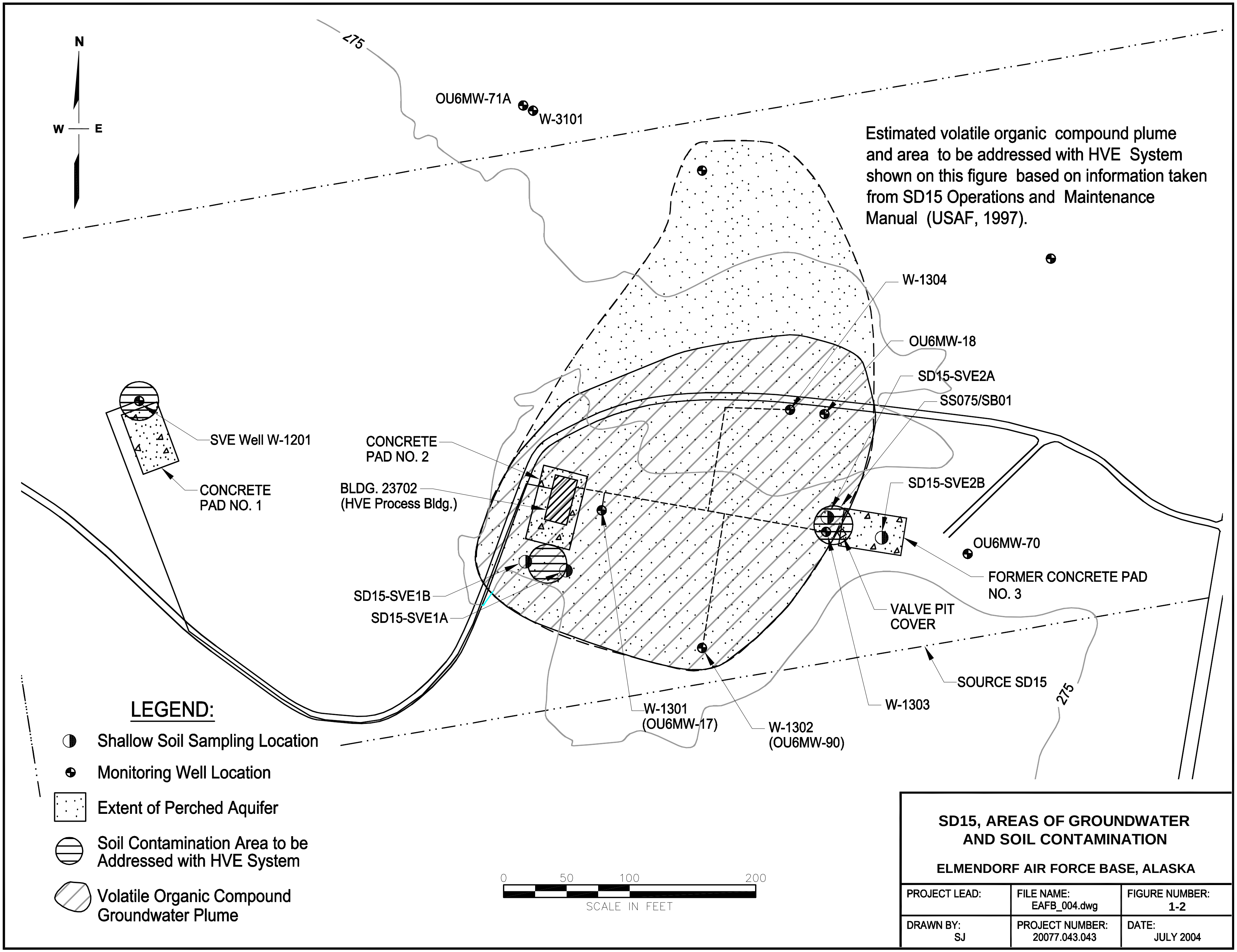
PROJECT LEAD:	FILE NAME:	FIGURE NUMBER: 1-1
DRAWN BY:	PROJECT NUMBER:	DATE: FEBRUARY 2004

Table 1-1 Remediation Goals, SD15

Chemical	Remediation Goal	Basis for Remediation Goal[1,2]
Groundwater (Perched Aquifer):		
Benzene	5 µg/L	MCL
Ethylbenzene	700 µg/L	MCL
Toluene	1,000 µg/L	MCL
1,1,2-Trichloroethane	5 µg/L	MCL
1,2-Dichloroethane	5 µg/L	MCL
Trichloroethene (TCE)	5 µg/L	MCL
Shallow Soils (0-5 feet bgs)		
Gasoline Range Organics (GRO)	1,000 mg/Kg	ACM, Level D
Diesel Range Organics (DRO)	2,000 mg/Kg	ACM, Level D
BTEX	100 mg/Kg	ACM, Level D
Deep Soils (>5 feet bgs)		
Gasoline Range Organics (GRO)	1,000 mg/Kg	ACM, Level D
Diesel Range Organics (DRO)	2,000 mg/Kg	ACM, Level D

[1] Basis for remediation goal is MCL, 40 Code of Federal Regulations (CFR) 141.61 for Federal MCLs, and (Alaska Administrative Code [AAC]) 18 AAC 80.070 for State MCLs presented in the Operable Unit 6 Record of Decision (USAF, 1997a).
[2] Basis for remediation goal is ACM, 18 AAC 78.315 presented in the Operable Unit 6 Record of Decision (USAF, 1997a).
ACM – Alaska Cleanup Matrix
bgs – below ground surface
ug/L – microgram per liter
mg/Kg – milligram per kilogram
BTEX – benzene, toluene, ethylbenzene and xylene
MCL – maximum contaminant level

Environmental monitoring will be discontinued at SD15 when the remediation goals have been achieved. This determination will be made jointly by the USAF, the United States Environmental Protection Agency (USEPA), and the State of Alaska pursuant to the Federal Facility Agreement (FFA).



SD15, AREAS OF GROUNDWATER AND SOIL CONTAMINATION

ELMENDORF AIR FORCE BASE, ALASKA

PROJECT LEAD:	FILE NAME: EAFB_004.dwg	FIGURE NUMBER: 1-2
DRAWN BY: SJ	PROJECT NUMBER: 20077.043.043	DATE: JULY 2004

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2.0 PROTECTIVENESS EVALUATION

The purpose of this protectiveness evaluation is to assess whether the remedial action implemented for SD15 is protective of human health and the environment. The evaluation will focus on the ability of the remedy to satisfy the remedial action objectives specified in the OU 6 ROD.

2.1 CURRENT PROTECTIVENESS

Remedy selection at SD15 currently protects human health and the environment in the short-term because operation of the HVE system has significantly reduced residual contamination and Land Use Controls are in place to eliminate known points of exposure.

Monitoring data in the perched aquifer shows that benzene and TCE concentrations at SD15 continue to remain slightly above remediation goals after seven years of HVE operation. Though contaminant of concern (COC) concentrations are significantly less than levels identified in 1994 and 1995, no discernable statistical trends have been established since 1999 for decreasing concentrations of benzene and TCE with the exception of benzene at OU6MW-90 and TCE at OU6MW-17 (USAF, 2002a). Furthermore, monitoring data suggests that remediation is approaching steady state conditions, and the selected remedy has not reduced COCs below remediation goals as predicted.

DRO, GRO, and BTEX concentrations exceed OU6 ROD cleanup criteria at two locations in relatively shallow soils above the perched aquifer (near former sampling locations SB-03 and SB-19). In 2003, the system was modified to incorporate SVE and two extraction wells, screened at the appropriate intervals, were placed near the center of the suspected contamination at each location.

Lastly, concern was expressed in the *Remedial Process Optimization Scoping Visit Report* (USAF, 2001a) that soil contamination may be present around Monitoring Well OU6MW-18. However, deep soil drilling conducted near HVE Well W-1304 in June 2002 (in proximity to OU6MW-18) returned very low or non-detectable concentrations of COCs for deep soils, suggesting that contamination at OU6MW-18 is probably confined to the perched aquifer medium.

Table 2-1 Current Status of OU 6 ROD Selected Remedy Components for SD15

No.	Remedy Component	Current Status
	Perched Aquifer Groundwater at SD15	
1	Institutional controls on land use and water use will restrict access to the contaminated groundwater throughout SD15. Installation of wells in the contaminated plume for residential, industrial, or agricultural use will be prohibited until cleanup levels have been achieved.	Ongoing. Land and groundwater restrictions are in place preventing risks due to contaminant exposure.
2	Groundwater in the perched aquifer at SD15 will be treated by an HVE process to remove fuel related contaminants and halogenated volatile organic compounds.	Ongoing. Approximately 335,350 gallons of groundwater in the perched aquifer have been treated by HVE through December 2003. Monitoring data shows that HVE has successfully reduced COC concentrations; and current data suggest that contaminant removal rates for TCE are approaching static conditions.
3	Recoverable quantities of free product found on top of the water table at SD15 will be removed through the HVE process.	Complete. No free product has been detected in wells at SD15 since 1999, but product level monitoring is ongoing.
4	Treated water will be reinjected into the subsurface beyond the boundary of the contaminated perched aquifer. Re-injected water will be regularly sampled to ensure it meets the cleanup and risk requirements.	Ongoing. Water is sampled regularly to verify that water injected into the subsurface meets the applicable cleanup & risk requirements.
5	Groundwater remaining above cleanup levels will continue to be monitored semi-annually and evaluated annually to determine contaminant migration and to track the progress of the HVE treatment, as well as to provide an early indication of unforseen environmental or human health risk. Five-year reviews will also assess the protectiveness of the remedial action, including an evaluation of any changed site conditions, as long as contamination remains above cleanup levels.	Ongoing. Groundwater at SD15 is currently being monitored annually as part of the Elmendorf AFB Basewide Groundwater Monitoring Program.
6	When contaminant concentrations in the groundwater are below cleanup levels during two consecutive monitoring events, HVE will be discontinued. Semi-annual monitoring will continue for another year, and subsurface soil samples will be collected. If levels are confirmed to be below cleanup levels one year after the system was shut-off, no further remedial action will be required. If contamination is present in any of the samples, the system will be restarted, or another remedial option will be considered.	Incomplete. Benzene and TCE still remain above remediation goals. However, four COCs previously identified above MCLs have been reduced below remediation goals.
7	During the final round of groundwater monitoring, samples will be collected and analyzed for all constituents that exceeded MCLs during the 1994 investigation including VOCs and arsenic. These results will be evaluated before a final decision is made that groundwater meets all cleanup requirements.	Incomplete. This task will be performed once the requirements have been met.
8	All groundwater is expected to be cleaned up within five years.	Incomplete. Benzene and TCE levels in perched aquifer groundwater continue to remain above remediation goals seven years after system start-up. All other COCs are below cleanup levels.

Table 2-1 Current Status of OU 6 ROD Selected Remedy Components for SD15 *(continued)*

No.	Remedy Component	Current Status
Deep Aquifer Groundwater at SD15		
1	No further action is required.	Complete.
Soils at SD15		
1	Shallow soils (less than 5 feet deep) with contamination above cleanup levels will be excavated, removed, and thermally treated to eliminate fuel related contaminants. After treatment, no further action will be required for the shallow soils.	Incomplete. Approximately 170 cubic yards of fuel-contaminated soil was excavated and thermally treated in 1996. Two areas of remaining contamination were included in an HVE Treatability Study. Shallow soil sampling conducted in 2002 indicates contamination above remediation goals remain at these two areas. Soil Vapor Extraction wells were installed in 2003 and began operation in February 2004.
2	Deep soils at SD15 will be actively treated through air stripping associated with the HVE process described for the perched aquifer groundwater.	Incomplete. Data returned from 2002 deep soil drilling demonstrate all deep soils have been treated below MCLs with the exception of the locality near HVE Well W-1303. At this location, contaminated soils exceed remediation goals to a depth of 11 feet bgs. This remaining contamination is in the interval to be treated by newly installed SVE wells.
3	Soils with contamination above cleanup levels will be sampled one year after system start and every three years thereafter to evaluate contaminant migration and timely reduction of contaminant concentrations by HVE. If cleanup levels are not being achieved, further remedial action will be evaluated. This will include five-year reviews to assess the protectiveness of the remedial action, as long as contamination remains above cleanup levels.	Ongoing. A three-year sampling event was conducted in 2002. Results indicate some soils are still contaminated above remediation goals. This information was presented in the five-year review. The sampling event will be planned for in FY 2005.
4	When two consecutive groundwater monitoring events indicate contaminant concentrations are below cleanup levels, the HVE system will be shut-off. Semi-annual monitoring will continue for another year, and subsurface soil samples will be collected. If levels are confirmed to be below cleanup levels one year after the system was shut-off, no further remedial action will be required. If contamination is present in any of the samples, the system will be restarted, or another remedial option will be considered.	Ongoing. Perched aquifer monitoring OU6MW-17, OU6MW-18, and OU6MW-90 are monitored annually as part of the Basewide Groundwater Monitoring Program. All still contain at least one COC above remediation goals.
5	All soils are expected to be cleaned up within five years.	Incomplete. Two areas of shallow soil contamination identified through soil sampling conducted in 1999 and 2002 will be actively remediated through use of SVE beginning in early 2004. Deep soil drilling conducted in 2002 indicates contaminant levels are below remediation goals with the exception of soils in the vicinity of HVE Well W-1303. A letter to the site file entitled “Memorandum to the Site File Elmendorf AFB Operable Unit 6”, which was signed by the AFB on 19 Sept 2003, modified sampling frequency.

AFB – Air Force Base
bgs – below ground surface
COC – chemical of concern
HVE – high-vacuum extraction
MCL – maximum contaminant level
TCE – trichloroethene
VOC – volatile organic compound

2.2 CURRENT REGULATORY COMPLIANCE

Groundwater in the perched aquifer at SD15 is monitored annually and soil samples are collected every three years to determine contaminant migration and to track the progress of the HVE treatment. A three-year sampling event was conducted in 2002 to track remediation progress in shallow soils since the first three-year sampling event conducted in 1999. Closure soil sampling was also conducted in deep soils near HVE Wells W-1302, W-1303, and W-1304. Closure soil sampling conducted in Year 2000 at SVE Well W-1201 demonstrated contaminant levels were well below remediation goals at this location.

2.2.1 Perched Aquifer at SD15

As shown in Table 2-2, groundwater samples collected from the three monitoring wells at SD 15 in the spring of 2003 and two wells at were sampled at SD15 in the spring and fall of 2002. These samples indicate benzene and TCE concentrations remain above remediation criteria. Samples were not collected from OU6MW-18 in 2002 due to the well being dry during both sampling rounds. No other COCs were identified above remediation goals.

2.2.2 Shallow Soils (0-5 feet bgs)

Shallow soils were sampled on June 24, 2002 per the protocol detailed in the Project Tasks Section 3.0 of the *Elmendorf SD15 Workplan, Final* (USAF, 2002b). Sampling locations are shown on Figure 2-1. Shallow soil samples were collected at the two known areas of shallow soil contamination sampled in 1999 (near former sampling locations SB-03 and SB-19). These samples satisfied the ROD requirement for tri-annual sampling of contaminated soil mediums to evaluate system performance and assess progress towards remediation.

As noted in Table 2-3, COCs exceeding remediation goals persist in the area just south of the HVE Process Building near former sampling locations SB03 and SB74 and near current HVE Well W-1303 in an area including former sampling locations SB19, SS03, SB01, SB76, and SB77. Year 2002 sample EHVE02-SB03C returned analytical data that was below remediation goals for DRO and total BTEX, but slightly above the remediation goal for GRO. Sample EHVE02-SB19C returned data that was below remediation goals for all COCs in the 4-6 foot below ground surface (bgs) interval; however, data from the 8-10 foot bgs interval was at or slightly above remediation goals for all COCs. Nearby sample EHVE02-1303C returned data above all shallow soil remediation goals in the 3-5 foot bgs interval; just below this interval concentrations of DRO and BTEX were below remediation goals though GRO levels are still elevated. No other areas of shallow soil contamination are known to exist in which any COCs exceed remediation goals at SD15.

Table 2-2 SD15 Perched Aquifer, 2002/2003 Analytical Results for Primary COCs

Well ID	Analyte	Units	2002 Analytical Results		2003 Analytical Results	Remediation Goal
			Spring	Fall	Spring	
W-1301 (OU6MW-17)	Benzene	µg/L	**13**	**22**	**100**	5
	Ethylbenzene	µg/L	0.17 F	0.37 F	ND (1.6)	700
	Toluene	µg/L	0.13 F	0.16 F	4.8	1,000
	1,1,2-Trichloroethane	µg/L	ND (0.10)	ND (0.10)	ND (0.11)	5
	1,2-Dichloroethane	µg/L	ND (0.11)	ND (0.11)	ND (0.17)	5
	Trichloroethene (TCE)	µg/L	**11**	**9.7**	**13**	5
OU6MW-18	Benzene	µg/L	NS	NS	**10**	5
	Ethylbenzene	µg/L	NS	NS	13	700
	Toluene	µg/L	NS	NS	ND (0.18)	1,000
	1,1,2-Trichloroethane	µg/L	NS	NS	ND (0.11)	5
	1,2-Dichloroethane	µg/L	NS	NS	ND (0.17)	5
	Trichloroethene (TCE)	µg/L	NS	NS	**20**	5
W-1302 (OU6MW-90)	Benzene	µg/L	1.3	0.37 F	.51	5
	Ethylbenzene	µg/L	ND (0.10)	ND (0.10)	ND (0.16)	700
	Toluene	µg/L	ND (0.10)	ND (0.10)	ND (0.18)	1,000
	1,1,2-Trichloroethane	µg/L	ND (0.10)	0.15 F	ND (0.11)	5
	1,2-Dichloroethane	µg/L	ND (0.11)	ND (0.11)	ND (0.17)	5
	Trichloroethene (TCE)	µg/L	**6.1**	**8.5**	**7.6**	5

Bolded number - indicates data exceeded remediation goals or cleanup levels.

F - The analyte was positively identified but the associated numerical value was below the method reporting limit.

( ) - Sample specific detection limit

ID - identification

µg/L - microgram per liter

ND - not detected

NS –not sampled

Table 2-3 SD15 Shallow Soils 2002 Results for COCs Exceeding Remediation Goals

Boring	Location	Depth (bgs)	Analytical Results[1]		
			DRO (mg/Kg)	GRO (mg/Kg)	BTEX (mg/Kg)
EHVE02-SB03C	Near Year 1999 sampling location E7-SB-03	5 - 7	1,400	**1,200**	51
EHVE02-SB19C	Near Year 1999 sampling location SB-19	4 - 6	1,700	840	74
		8 – 10 [2]	**2,600**	**1,600**	100
EHVE02-SB1303C	Near former sampling location SS075/SB01and E7-SS-03	3 - 5	**8,800**	**1,800**	**149**
		4.5 - 6.5	1,600	**1,200**	14
Remediation Goal	--	--	2,000	1,000	100

[1] Samples collected on June 24, 2002.

[2] Data from the 8-10 foot interval of boring SB-19C are included in this table as contamination at this depth is a continuation of that found in the 4-6 foot interval. Shallow soil treatment method will also address contamination found at this depth.

Bold - indicate data exceeded the remediation goal.

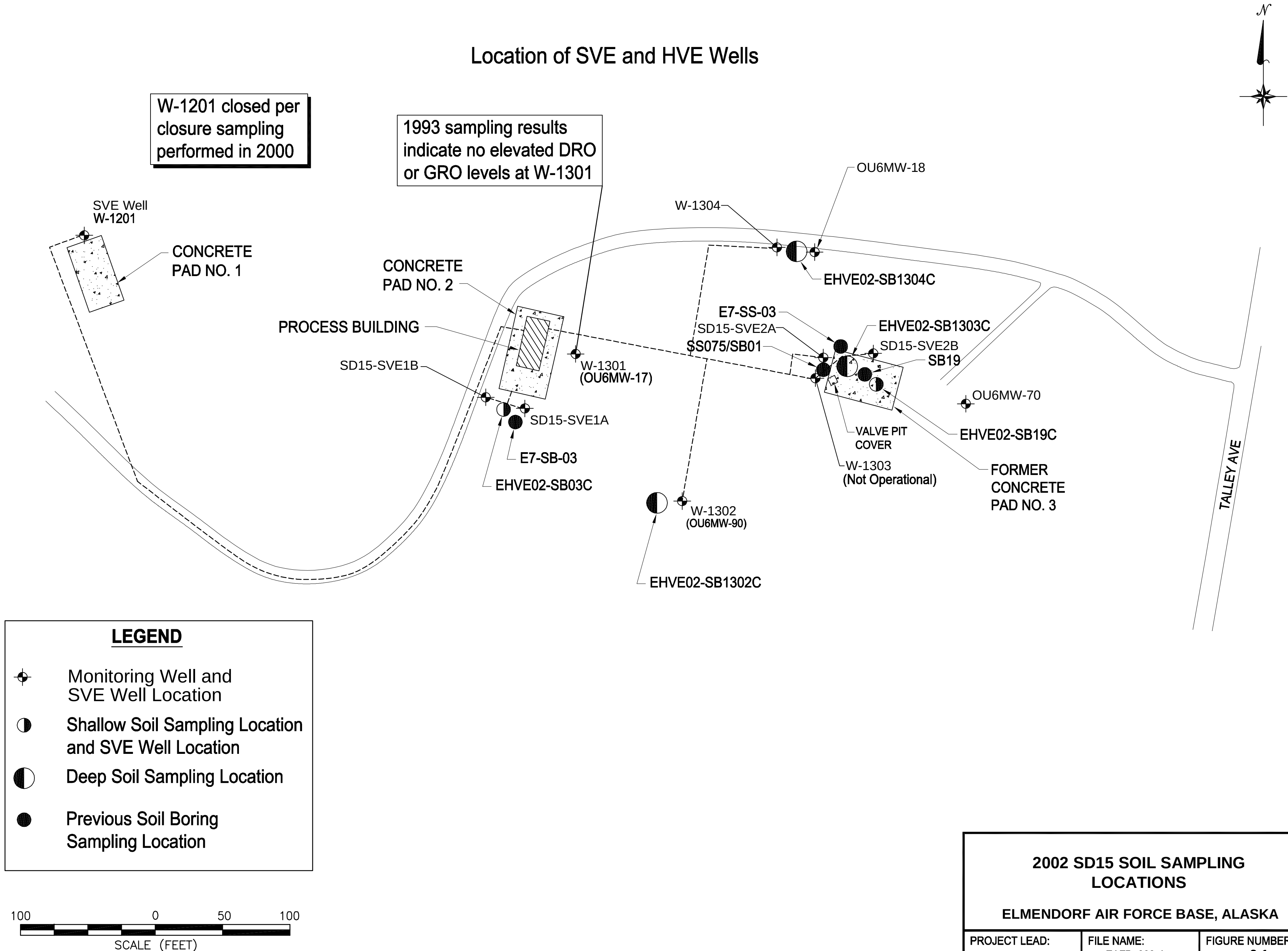
bgs - below ground surface

BTEX - benzene, toluene, ethylbenzene, and xylenes

DRO - diesel range organic

GRO - gasoline range organic

mg/Kg - milligram per kilogram



2002 SD15 SOIL SAMPLING LOCATIONS

ELMENDORF AIR FORCE BASE, ALASKA

PROJECT LEAD:	FILE NAME: EAFB_003.dwg	FIGURE NUMBER: 2-1
DRAWN BY: SJ	PROJECT NUMBER: 20077.043.043	DATE: JULY 2004

2.2.3 Deep Soils (>5 feet bgs)

Deep soil sampling was performed in June of 2002 to document progress of deep soil treatment at these locations. Sampling was performed per the protocol detailed in Project Tasks Section 3.0 of the *Elmendorf SD15 Workplan, Final* (USAF, 2002b). Samples were collected near HVE Wells W-1302, W-1303, and W-1304 to determine the reduction of contaminant levels and allow comparison to cleanup goals. A summary of analytical results is presented in Table 2-4.

Table 2-4 SD15 Deep Soils 2002 Analytical Results for COCs

Sample Identification	Location	Depth (bgs)	Analytical Results[1]	
			DRO (mg/Kg)	GRO (mg/Kg)
EHVE02-SB19C	Near Year 1999 Sampling Location SB-19C	8-10	**2,600**	**1,600**
EHVE02-SB1302C	Near HVE Well 1302 (OU6MW-90)	11-13	ND (5.1)	ND (2.3)
		19.5-21.5	ND (4.8)	ND (2.1)
		24-26	ND (5.4)	3.9
		30-32	ND (5.4)	11
		40-42	5.2 F	3.3
		50-52	ND (4.8)	ND (2.1)
EHVE02-SB1303C	Near HVE Well W-1303	9-11	1,200	**2,200**
		20-22	ND (4.7)	ND (2.1)
		30-32	ND (4.9)	ND (2.2)
		40-42	ND (5.1)	ND (2.2)
		48.5-50.5	36	55
		50-52	ND (5.3)	2.7 F
EHVE02-SB1304C	Near HVE Well W-1304	10-12	ND (5.1)	ND (2.2)
		23-25	ND (5.5)	ND (2.4)
		30-32	16	ND (2.1)
		45-47	ND (4.9)	3.0
		50-52	ND (4.9)	2.5
Remediation Goal	--	--	2,000	1,000

[1] Samples collected on June 24-25, 2002.

Bold - indicate data exceeded the remediation goal.

( ) – sample specific detection limit

F – The analyte was positively identified but the associated numerical value was below the method reporting limit.

bgs - below ground surface

DRO - diesel range organic

GRO - gasoline range organic

mg/Kg - milligrams per kilogram

ND – not detected

Only two samples failed to meet remediation goals established for deep soils: DRO and GRO results at the 8-10 foot bgs interval from sample EHVE02-SB19C and GRO result at the 9-11 foot bgs interval from sample EHVE02-SB1303C. Remediation in deep soils near HVE Well

W-1302 and Well W-1304 should be considered complete. Contamination found at HVE Well W-1303 is localized and found just below shallow soils; all other samples collected from the location were below cleanup goals.

2.2.4 Historical Soil Data

Data and conclusions from this drilling can be found in the 2000 SD15 Annual Report (USAF, 2000a). In summary, findings were as follows:

- Exceedences of remediation goals established for SD15 in the OU6 ROD were found at SB-74 from 4-6 feet bgs for GRO (1,800 milligram per kilogram [mg/Kg]) in 1999.
- Exceedences of remediation criteria were found at SB-76 from 9-11 feet bgs for GRO (1,500 mg/Kg) in 1999.
- Exceedences of remediation criteria were found from 4-6 feet bgs for DRO, GRO, and BTEX (3,100 mg/Kg, 5,400 mg/Kg, and 338 mg/Kg, respectively).

All of these locations are either within shallow soils or immediately below the shallow soil boundary (5 feet bgs); these areas have not been actively treated to date. No soil contamination was found below 11 feet bgs in any of the 1999 soil borings.

Analytical data from soil sampling at SVE Well W-1201 demonstrated the HVE system's ability to treat shallow soil contamination. DRO concentrations of 500 mg/Kg and GRO concentrations of 1,200 mg/Kg were reduced to non-detectable levels by August 2000, demonstrating that the HVE system is capable of reducing DRO contamination in soils.

Shallow soils in the area surrounding W-1303 in 1993 reported concentrations of DRO at 10,000 mg/Kg (E7-SS-03 at 1 foot bgs) and GRO concentrations of 21,000 mg/Kg (E7-SB-01 at 2.5 – 4.5 feet bgs) (USAF, 1996). Samples collected from borings placed in 2002 at approximately the same sampling locations returned DRO concentrations of 8,800 mg/Kg (EHVE02-130C at 3 – 5 feet bgs) and GRO concentrations of 1,800 mg/Kg (EHVE02-1303C at 3 – 5 feet bgs). This suggests that Well W-1303 is not as effective at treating shallow soils in this area if compared to the results returned from Well W-1201 and supports the recommendation to modify the system to treat these shallow soils. The reduction in GRO concentration is probably a result of volatilization of these lighter range organics and, if so, SVE should be an effective treatment. The two SVE wells installed in this area will begin operation in early 2004.

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3.0 SYSTEM PERFORMANCE EVALUATION

A system performance evaluation is conducted on an annual basis to track the progress of remediation at the site and to ensure that the system is operating properly and efficiently. SD15 HVE system operation and maintenance (O&M) tasks occurring during the reporting period are described in this section. O&M tasks during the period January – May 2003 were performed under a separate contract and are documented in the Systems Status Report, dated 2 June 2003, (USAF, 2003a) and therefore not discussed in detail in this report. However, SD 15 performance data during this period have been extracted from the referenced report and combined with data obtained during performance of this Task Order to consolidate the data in one report.

3.1 SCHEDULED MONITORING

The SD15 HVE system is scheduled for monitoring and sampling on a regular basis to determine if the system is operating efficiently and to estimate the mass of contamination being removed from the subsurface. System performance is evaluated using historical data, liquid and vapor phase data, monitoring well data, and the periodic collection of subsurface soil data. A summary of the monitoring tasks planned for 2003, including their frequency and purpose, is presented in Table 3-1. Actual monitoring tasks, including vapor phase sampling at newly installed SVE wells, were not performed at this frequency as the system experienced a series of equipment failures and the downtime precluded the collection of samples. The system should be running for a minimum of 48 continuous hours to provide an accurate representation of site conditions prior to the collection of a steady-state sample. Collection of samples before the system has reached steady-state may provide misleading data on the system's efficiency.

Table 3-1 Year 2003 Monitoring Schedule for SD15 HVE System

Frequency	Task	Purpose
Weekly	Record process information (e.g., flow rate, pressure, and volume).	To evaluate the performance of the system and provide data to determine the quantity of contamination removed from the subsurface.
Monthly	Record product thickness and water level at well No. OU6MW-18	To determine if the perched aquifer has been dewatered and to quantify the effects of the system on the subsurface product layer.
	Sample effluent water after first carbon vessel.	To determine if breakthrough occurred and to verify that water being injected into the subsurface meets the cleanup and risk requirements.
	Sample vapor phase at discharge stack.	To quantify the total amount of contamination removed through the vapor phase for the entire system.
Quarterly	Sample vapor phase at each well.	To quantify the amount of contamination removed through the vapor phase at each extraction well.
	Sample influent water before oil/water separator; analyses alternated between events for VOCs and GRO/DRO.	To determine the mass of contamination removed through the liquid phase.
	Sample vapor phase at newly installed SVE wells.	To quantify the amount of contamination removed through the vapor phase at each source.

DRO - diesel range organic
GRO - gasoline range organic
VOC - volatile organic carbon

3.2 CONTAMINANT REMOVAL SUMMARY

This subsection contains a summary of the data gathered from 2003 monitoring. Data gathered from influent water sampling and discharge stack vapor monitoring is used to calculate a mass of contamination removed from the subsurface over the course of the year. The objectives for sample collection at SD15 were to:

- Monitor treated water to ensure it meets cleanup and risk requirements prior to reinjection.
- Document influent groundwater concentrations of volatile organic compounds (VOCs), GRO, and DRO to monitor performance of the HVE system and contaminant removal rates.
- Document vapor concentrations of VOCs, halogenated volatile organic compounds (HVOCs), and the alkane hydrocarbon series for air quality compliance and to determine the mass of contaminants removed.
- Evaluate data to determine if the system is reducing contaminant levels to remediation goals established in the OU 6 ROD.

The type and the analytical methods used to meet project objectives are provided in Table 3-2.

Table 3-2 Year 2003 Sample Analysis Summary

Matrix	Analyses	Method
Water	DRO	AK102
	VOC	SW846-8260B
Vapor	AVO/HVOC	Modified TO14A
	Methane (C1)	ASTM 1945
	C2-C4	Air Toxics M82
	C5-C10 Alkanes	Modified TO3

AVO - aromatic volatile organic
DRO - diesel range organic
HVOC - halogenated volatile organic compound
VOC - volatile organic compound

3.2.1 Influent and Effluent Water Sampling

Liquid phase data collected in 2003 include flow rates and analytical samples. Analytical samples were collected at two different points in the system: upstream of the oil/water separator (influent); and downstream of the first carbon vessel (effluent). Small amounts of free product (less than one pint) from bail down of monitoring wells was added to the oil/water separator for treatment using the oil/water separator and the GAC. Because contaminants are measured before the oil/water separator, adding these contaminants did not affect the system's contaminant removal amount or rates Influent and effluent water analytical data was used to calculate the mass of VOCs, including GRO, and DRO contamination extracted. This information was also used to document that discharged and injected wastewater from the HVE system met cleanup and risk requirements. Liquid phase samples collected in 2003 and their locations and designations are shown in Table 3-3. The system operated for 5,222 hours during the 12-month period from January 1 - December 31, 2003, extracting a total 53,870 - gallons of water. Liquid phase operating parameters are provided in Table 3-4.

Table 3-3 Liquid Phase Samples Collected in 2003

Sample ID	Date	Location	Designation
ENVE02-W-2005	6-Feb-03	After the first carbon canister	Effluent
ENVE02-W-2006	26-Mar-03	After the first carbon canister	Effluent
SD15-CV-03-1	26-Sep-03	After the first carbon canister	Effluent
SD15-IN-03-1	26-Sep-03	Before the oil/water separator	Influent

ID - identification

Table 3-4 Liquid Phase Operation Parameters for 2003

Date	Hours of operation	Liquid flow rate (gallon/minute)	Extraction volume (gallons)	Average flow rate (gallons/day)
Jan-03	234.2	0.120	1,680	172.161
Feb-03	742	0.317	14,100	456.065
March-03	670	0.323	12,982	465.027
April-03	743.3	0.332	14,822	478.579
May-03	698.6	0.223	9,366	321.764
Jun -03	NA	NA	NA	NA
July-03	399	0.016	372	22.376
Aug-03	342.2	0.010	200	14.027
Sept-03	379.8	0.009	207	13.081
Oct-03	607.1	0.002	80	3.163
Nov-03	328.1	0.003	53.9	3.943
Dec-03	77.9	0.001	6.6	2.033
Totals	5,222	--	53,870	--

NA – Data not available as June 2003 was time period of contractor change over. No data collected.

3.2.1.1 Influent Sampling

An influent water sample was collected in September of 2003 from a sample port located upstream of the oil/water separator and was analyzed for DRO and VOCs. Samples were not collected during according to the project schedule due to system inoperability and requirements of the system reaching steady state prior to influent sampling. The analytical result from this sample was assumed to represent an average influent concentration and was used to calculate the mass of contamination removed by the system in the liquid phase. Influent sample analytical data are summarized in Table 3-5 and calculated mass removal rates are shown in Table 3-6.

Table 3-5 2003 Influent Water Analytical Data

Location	Sample port before oil/water separator
Sample ID	SD15-IN-03-1
Collection Date	26-Sep-03
COCs and Detected Analytes	
DRO (μg/L)	673
VOC (μg/L)	6.79

COC – chemical of concern
DRO - diesel range organic
ID – identification, μg/L - microgram per liter

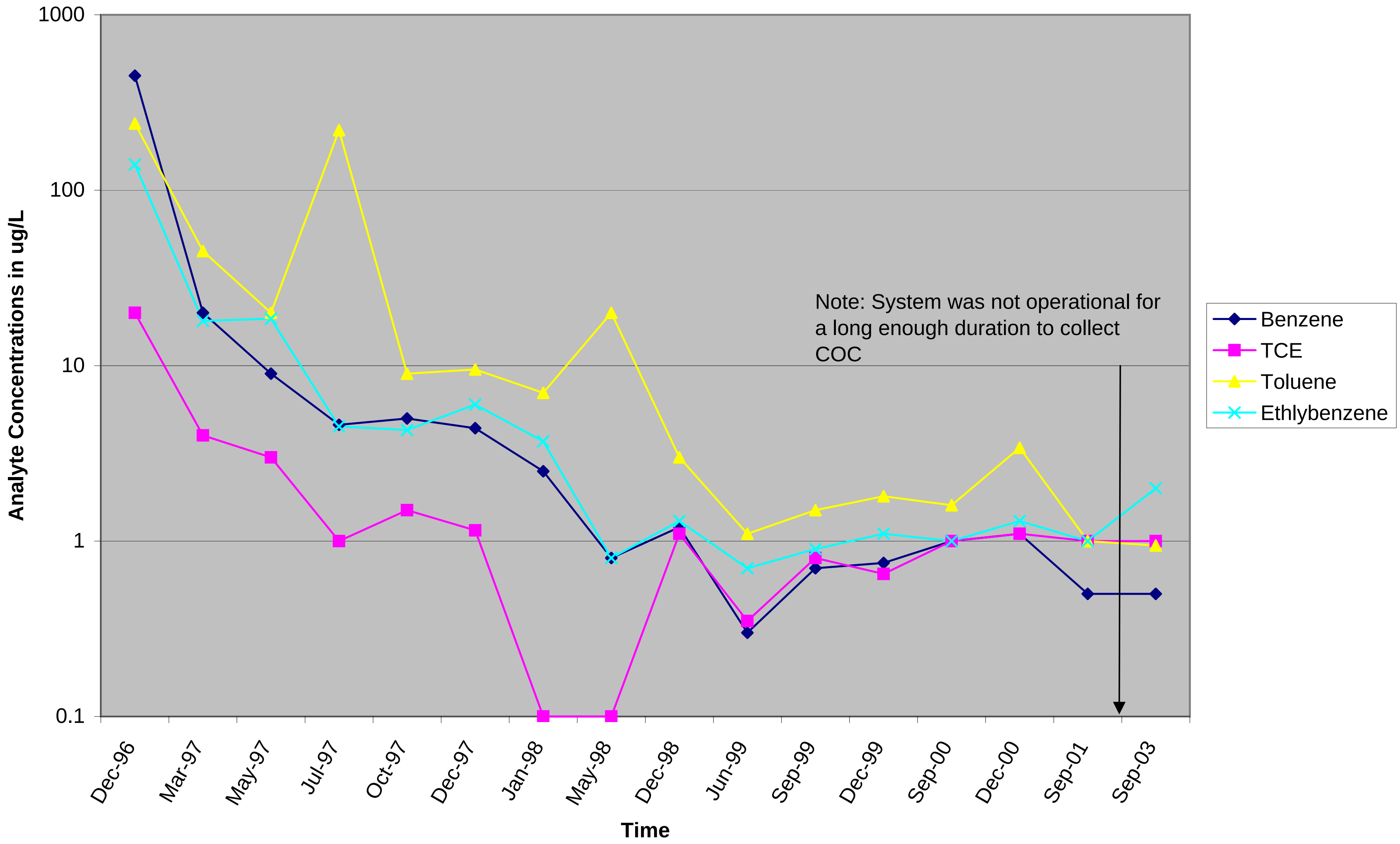
Table 3-6 Liquid Phase Mass Removal Rates for 2003

	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Totals
DRO[a] (lbs)	7.9E-2	7.3E-2	8.3E-2	5.2E-2	4.4E-2	NA	2.2E-3	1.2E-3	1.2E-3	4.1E-4	3.3E-4	2.6E-5	3.4E-1
VOC[b] (lbs)	7.8E-4	7.2E-4	8.2E-4	5.2E-4	4.3E-4	NA	1.7E-5	9.1E-6	9.1E-6	3.2E-6	2.6E-6	2.1E-7	3.3E-3

(lbs) – pounds of contaminant removed.
NA – Data not available as June 2003 was time period of contractor change over. No data collected.

Figure 3-1 shows the change in concentrations over time of the liquid phase since the SD15 system has been in operation. This figure does not show the COCs 1,1,2-trichloroethene and 1,2-dichlorethene because the influent concentrations of these compounds have been less than the method reporting limits (MRLs) during the time the HVE system have been operational. The mass of contamination removed as VOCs in the liquid phase have historically been low. In 1997, the cumulative quantity of VOC contamination removed in the liquid phase was only 0.2 pounds. Higher flow rates and a different quantification of contaminants resulted in an estimated 6.45 pounds of VOCs removed in the liquid phase in 1998. The quantity of VOCs removed in 1999 was approximately 0.52 pounds, 0.01 pounds in 2000, 0.018 pounds in 2001, 0.0005 pounds in 2002, and .0041 pounds in 2003.

Figure 3-1 Concentration of Contaminants of Concern in Liquid Phase



Based on calculations from influent water sample analytical data, the cumulative mass of COCs removed in the liquid phase since December 1996 is approximately 7.378 pounds. This value is biased low because the mechanical extraction process strips VOCs from the liquid waste stream prior to the sample collection point. The removal rates for GRO and DRO are significantly higher than those calculated for VOCs, in part because the unspeciated fuel hydrocarbons are less volatile than VOCs; therefore, it is less likely that these constituents, especially DRO, will migrate from the liquid to vapor phase during the remediation process. Thus explains the DRO is consistently reported in the system's influent water data.

3.2.1.2 Monthly Effluent Water Sampling Results

Three effluent water samples were collected from a sample port between the first and second carbon vessels to verify the effectiveness of the water treatment system (i.e., two activated carbon canisters in series). These samples, collected on February 6, March 26, and September 26, 2003, were analyzed for VOCs and the results used to verify that groundwater is being treated in accordance with the OU 6 ROD (USAF, 1997a). Samples were scheduled to be collected on a monthly basis; however, significant system downtime and lack of consistent operability prevented collection of additional samples. Effluent data are shown in Table 3-7. A review of the analytical data shows that VOCs were less than the reporting limit (i.e., non-detected) during the period of performance. These data confirm that the treatment system is reducing the concentration of VOCs in the waste stream. In addition, this data verifies that groundwater is being treated in accordance with the OU 6 ROD, which requires that the detected concentration for total petroleum hydrocarbons (TPH) is less than 1 part per million (ppm) (or 1 milligram per liter [mg/L]) and the COCs are less than the drinking water MCL.

Table 3-7 2003 Effluent Analytical Data

Sample ID	SD15-CV-03-1
Collection Date	26-Sep-03
COCs and Detected Analytes [1]	
1,1,2,2-Tetrachloroethane (μg/L)	ND (0.5)
1,1-2- Trichloroethane (μg/L)	ND (1.0)
1,2 Dichloroethane (μg/L)	ND (1.0)
Benzene (μg/L)	ND (0.4)
Ethylbenzene (μg/L)	ND (1.0)
Trichloroethene (μg/L)	ND (1.0)
Toluene (μg/L)	ND (1.0)

[1] - Data are provided for COCs or those analytes detected in an associated sample.
( ) - Reporting limit is provided in parentheses.
COC – chemical of concern
ID - identification
μg/L - microgram per liter
ND - not detected

3.2.1.3 Quarterly and Monthly Vapor Samples

The operating efficiency of the HVE system at stripping contaminants through vapor extraction is assessed by measuring the vapor flow rate and by reviewing analytical data gathered from vapor samples. Vapor samples are collected from two different points in the system: the effluent vapor at the air discharge stack (monthly); and the influent vapor at the HVE wells (quarterly). Sample frequency again was less than scheduled due to numerous system shutdowns and the need to allow the necessary equilibration time to elapse before sampling. Samples collected in 2003, are summarized in Table 3-8.

Table 3-8 Vapor Phase Samples

Sample Type	Sample ID	Sample Collection Date
Air Discharge Stack	EHVE02-A-2005	6-Feb-03
	EHVE02-A-2006	26-Mar-03
	SD15-STACK-092503	25-Sep-03
	SD15-STACK-110303	3-Nov-03
HVE Wells (W-1301, W-1302, W-1303, W-1304)	SD15-1301-092503	25-Sep-03
	SD15-1302-092503	25-Sep-03
	SD15-1303-092503	25-Sep-03
	SD15-1304-092503	25-Sep-03

Note: Copies of the vapor production log are provided in Appendix A.
HVE – high-vacuum extraction
ID – identification

3.2.1.4 Quarterly Vapor Results from HVE Wells

Vapor samples were collected from each HVE wellhead on September 25, 2003. Analytical results are shown in Table 3-9. This data was used to determine the mass of contamination being removed from each HVE well. The majority of vapor phase contaminant removal occurred at HVE Wells W-1303 and W-1304. A higher contaminant concentration at these two wells is consistent with historical data indicating fuel contamination near W-1303 and free product in the vicinity of W-1304 (i.e., OU6MW-18).

Table 3-9 2003 Vapor Phase Analytical Data - HVE Wells

Sample ID	SD15-1301-092503	SD-15-1302-092503	SD15-1303-092503	SD15-1304-092503
Sample Locations	**W-1301**	**W-1302**	**W-1303**	**W-1304**
Collection Date	**25-Sep-03**	**25-Sep-03**	**25-Sep-03**	**25-Sep-03**
Analytes				
1,1, Dichloroethene (μg/L)	ND (.024)	ND (.022)	ND (.022)	ND (.020)
1,1,1-Trichloroethane (μg/L)	ND (.034)	ND (.030)	ND (.030)	ND (.027)
Benzene (μg/L)	0.05	ND (.018)	0.029	0.026
Carbon Tetrachloride (μg/L)	ND (.039)	ND (.034)	.012 J	.010 J
Ethane (μg/L)	ND (.188)	ND (.163)	ND (.163)	ND (.15)
Ethene (μg/L)	ND (.188)	ND (.163)	ND (.163)	ND (.15)
Ethylbenzene (μg/L)	ND (.027)	ND (.024)	0.016	0.037
Heptane (μg/L)	ND (.025)	ND (.022)	2.2	1.4
Hexane (μg/L)	ND (.022)	ND (.019)	0.42	0.47
Methane (μg/L)	NA	NA	NA	NA
Nonane (μg/L)	NA	NA	NA	NA
Octane(μg/L)	NA	NA	NA	NA
Pentane (μg/L)	NA	NA	NA	NA
Trichloroethene (μg/L)	.0094 J	.0093 J	0.16	0.13
Toluene (μg/L)	.0045 J	ND (.021)	0.24	0.29
m,p-Xylene (μg/L)	ND (.027)	ND (.024)	1	0.34
o-Xylene (μg/L)	ND (.027)	ND (.024)	0.9	0.18
Total C5-C10 (ppmv)	0.03	0.0	1.865	1.0

( ) – sample specific detection limit
ID – identification
μg/L – microgram per liter
NA – not analyzed
ND – not detected
ppmv – part per million by volume

Wells W-1301 and W-1302 do not exhibit high concentrations of contaminants in the vapor phase, but these wells are responsible for extracting most of the contaminated groundwater from the site. Soil sampling conducted in 1994 during construction of W-1301 indicated no elevated levels of COCs in deep soils. Deep soil sampling conducted in Year 2002 at W-1302 returned data that indicated no contamination exists in deep soils at this location.

3.2.1.5 Monthly Vapor Discharge Stack Results

Vapor flow rate at the discharge stack is calculated from differential pressure at the discharge stack. When the system is fully operational and all the wells are on line, vapor flow averages about 169 standard cubic feet per minute (scfm). Analytical results from discharge stack sampling are shown in Table 3-10. Vapor samples were collected from the discharge stack on February 6. March 26, and September 25, and November 3. The available analytical results and the average monthly vapor flow rate were used to quantify the mass of contamination removed in the vapor phase. Vapor flow rates and mass removal rates for vapor phase contamination are shown in Table 3-11.

The cumulative mass of VOCs (total), HVOCs, and BTEX contamination removed since the system went on line is shown in Table 3-12. It is apparent from the data that the mass of contamination removed has decreased over time. The asymptotic nature of the removal curve and the reduction in mass removal rates through time indicate that steady state conditions are being reached, as shown graphically in Figure 3-2.

3.3 SD15 PERCHED GROUNDWATER SAMPLING RESULTS

Four wells at SD15 have historically been sampled in two rounds as part of the Basewide Support and Groundwater Monitoring Program (one round in the summer and one in the fall). In 2003, this frequency was changed to annually. Two of these wells are used as extraction wells for the HVE system, W-1301 (OU6MW-17) and W-1302 (OU6MW-90). A third well, OU6MW-18, lies approximately 25 feet east of W-1304 (Figure 1-3). The fourth well, OU6MW-70, is placed within the deep aquifer at SD15. Analytical data from the 2002 groundwater sampling events are summarized for SD15 COCs in Table 2-2. Because OU6MW-70 lies within the deep aquifer and has consistently returned analytical data below remediation goals, it will not be discussed further in this report.

Monitoring wells OU6MW-17, OU6MW-18, and OU6MW-90 were sampled in the spring of 2003. Year 2003 analytical data indicate that Monitoring Well OU6MW-17 and OU6MW-18 both exceeded the benzene remediation goal of 5 micrograms per liter (μg/L) and the TCE remediation goal of 5 μg/L. This is consistent with historical patterns at these well locations. Monitoring wells OU6MW-90 returned analytical data that was below remediation goals for benzene but slightly exceeded TCE remediation goals.

Figures 3-3 through 3-5 graphically illustrates trends in the two COCs in perched groundwater at SD15. At OU6MW-17, after a spike in benzene concentrations from the fall of 1999 through the fall of 2000, a downward trend is apparent through the spring of 2002 although there was a slight rebound in the fall of 2002 and a spike in 2003. TCE concentrations have decreased since system startup in 1997. However, the decrease in TCE concentrations has lessened with relatively little fluctuation in a narrow range of concentrations since the spring of 2001. At OU6MW-90, benzene concentrations remain below remediation goals and TCE concentrations remained in the narrow range observed since monitoring of this well began in 1996.

Table 3-10 2003 Vapor Phase Analytical Data – Discharge Stacks

Sample ID	SD15-STACK-092503	SD15-STACK-110303
Collection Date	**25-Sep-03**	**3-Nov-03**
Analytes		
1,1, Dichloroethane (μg/L)	ND (.016)	ND (.016)
1,1,1-Trichloroethane (μg/L)	ND (.023)	0.03
Benzene (μg/L)	0.07	0.039
Ethane (μg/L)	ND (0.125)	ND (0.125)
Ethene (μg/L)	ND (0.116)	ND (0.116)
Ethylbenzene (μg/L)	0.08	0.033
Heptane (μg/L)	1.7	0.8
Hexane (μg/L)	0.45	0.26
Methane (μg/L)	NA	NA
Nonane (μg/L)	NA	NA
Octane (μg/L)	NA	NA
Pentane (μg/L)	NA	NA
Trichloroethene (μg/L)	0.15	0.094
Toluene (μg/L)	0.32	0.094
m,p-Xylene (μg/L)	0.59	0.22
o-Xylene (μg/L)	0.46	0.19
Total C1-C4 (μg/L)	NA	NA
Total C5-C10 (ppmv)	.658	1.345

( ) – sample specific detection limit
ID - identification
μg/L – microgram per liter
NA – not analyzed
ND – not detected
ppmv – part per million by volume

Table 3-11 Vapor Phase Flow and Mass Removal Rates

	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03	Totals
Average Flow Rate When Operational (scfm)	261.28	161.13	165.38	183.73	195	NA	169	159.8	166.2	164.17	163.67	163.33	--
VOC, total (pounds)	.825	.459	.523	.546	.555	NA	.851	.689	1.083	.4424	.229	0.054	6.24
HVOC (pounds)	0.028	0.015	0.017	0.018	0.019	NA	0.028	0.023	0.036	0.014	0.008	0.002	0.209
BTEX (pounds)	.784	.436	.497	.519	.527	NA	.808	.654	1.029	.403	.217	.051	5.926

BTEX – benzene, toluene, ethylbenzene, and xylenes
HVOC – halogenated volatile organic compound
scfm – standard cubic fuel per minute
VOC – volatile organic compound
NA – Data not available as June 2003 was time period of contractor change over. No data collected.

Table 3-12 Summary of Vapor Phase Data through December 2003

Vapor Phase Parameter	Year 1 (1997)	Year 2 (1998)	Year 3 (1999)	Year 4 (2000)	Year 5 (2001)	Year 6 (2002)	Year 7 (2003)	Total
Run time (hours)	7,040	5,466	5,821	1,859	4,721	2,291	5,222	32,420
Run Time Percent (%)	80.1	62.4	66.4	21.1	53.9	26.2	59.7	--
Mass of total VOCs removed (pounds)	7,543	1,060	797	413	220.4	53.32	6.24	10,092.96
Mass of HVOCs removed (pounds)	23	4	2.91	0.62	0.74	0.12	0.209	31.60
Mass of BTEX removed (pounds)	133	18	41.57	4.07	13.26	3.13	5.926	218.96

BTEX - benzene, toluene, ethylbenzene, and xylenes
HVOC - halogenated volatile organic compound
VOC - volatile organic compound

Figure 3-2 VOC Removal Curve

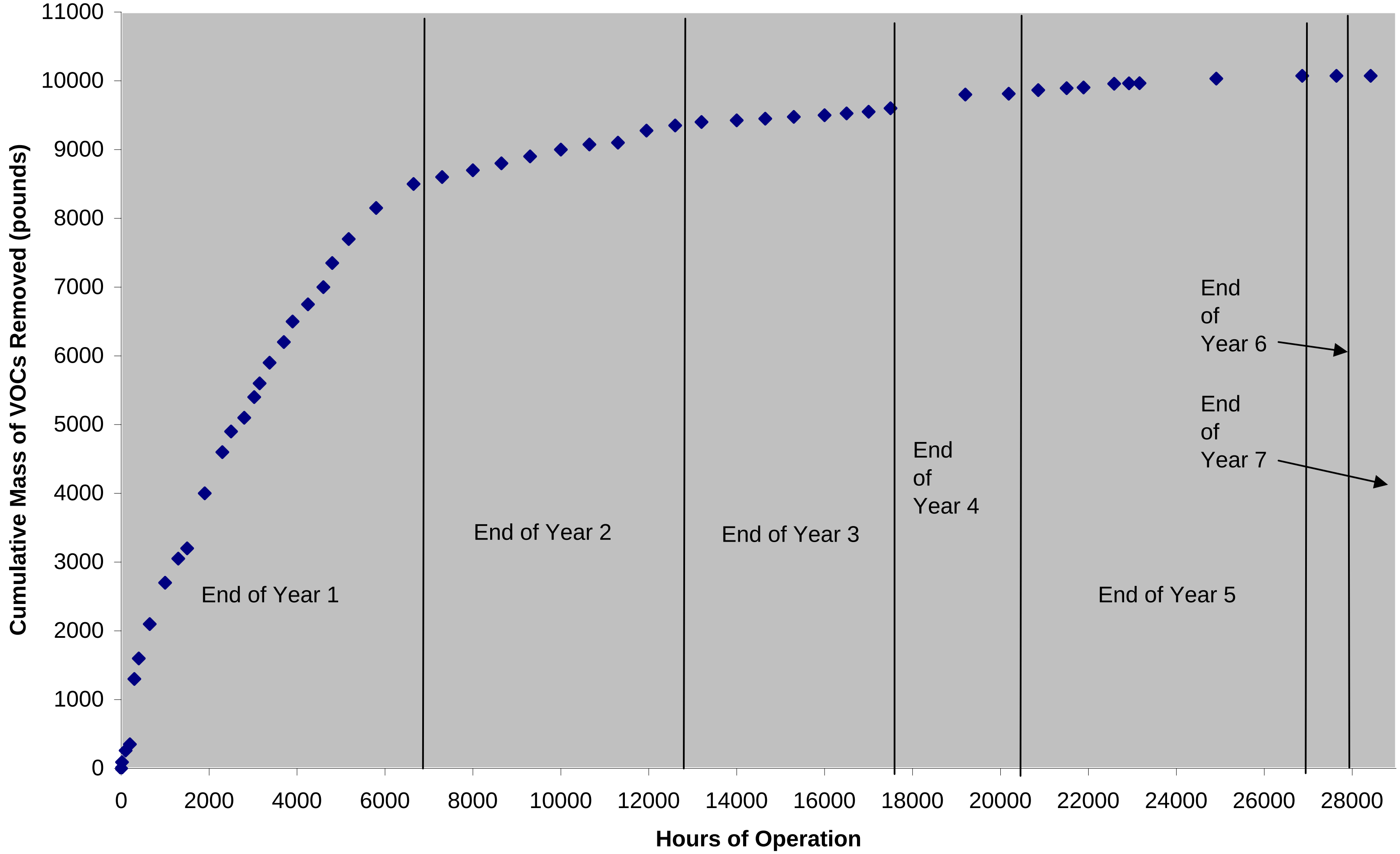
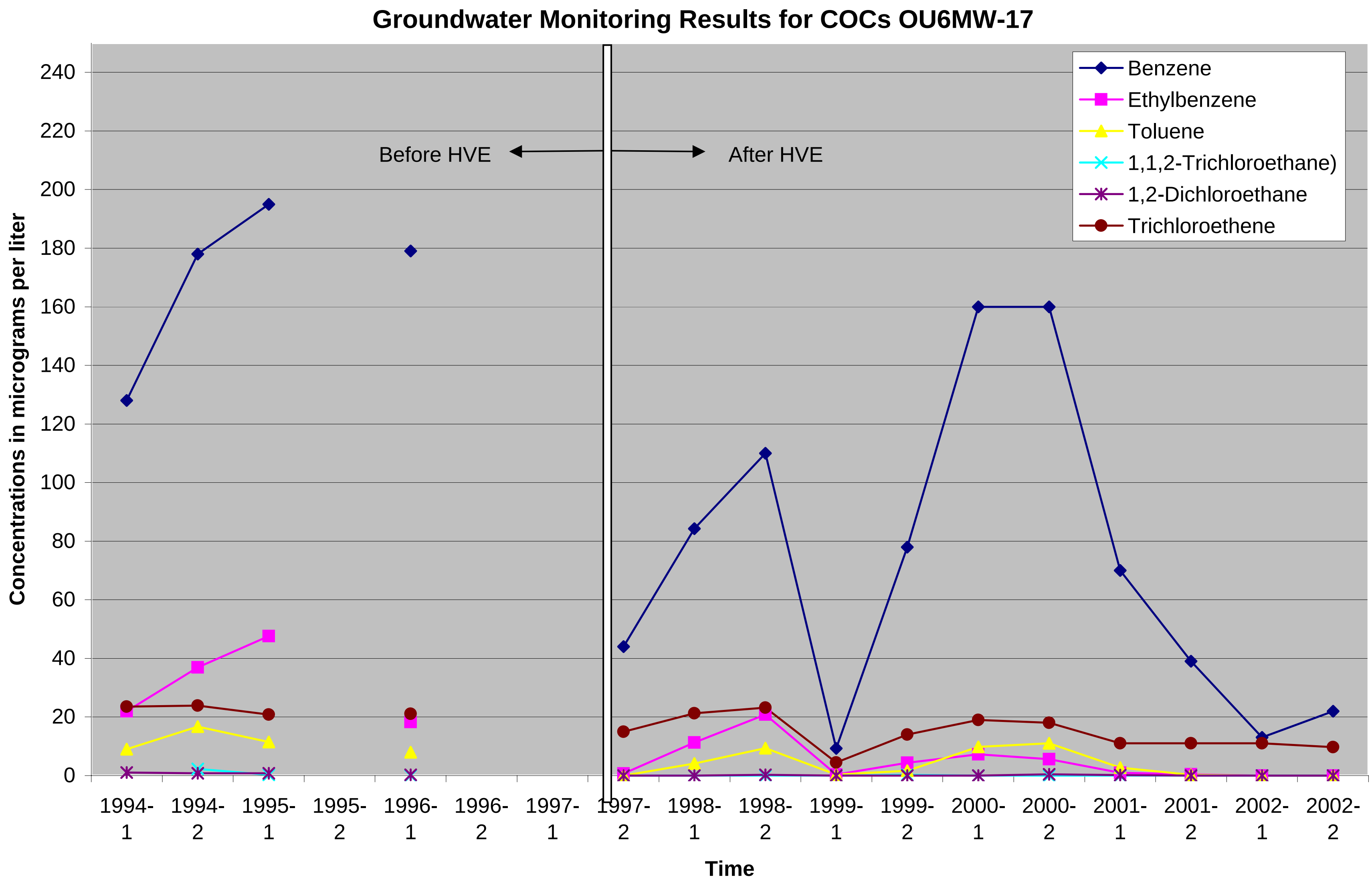
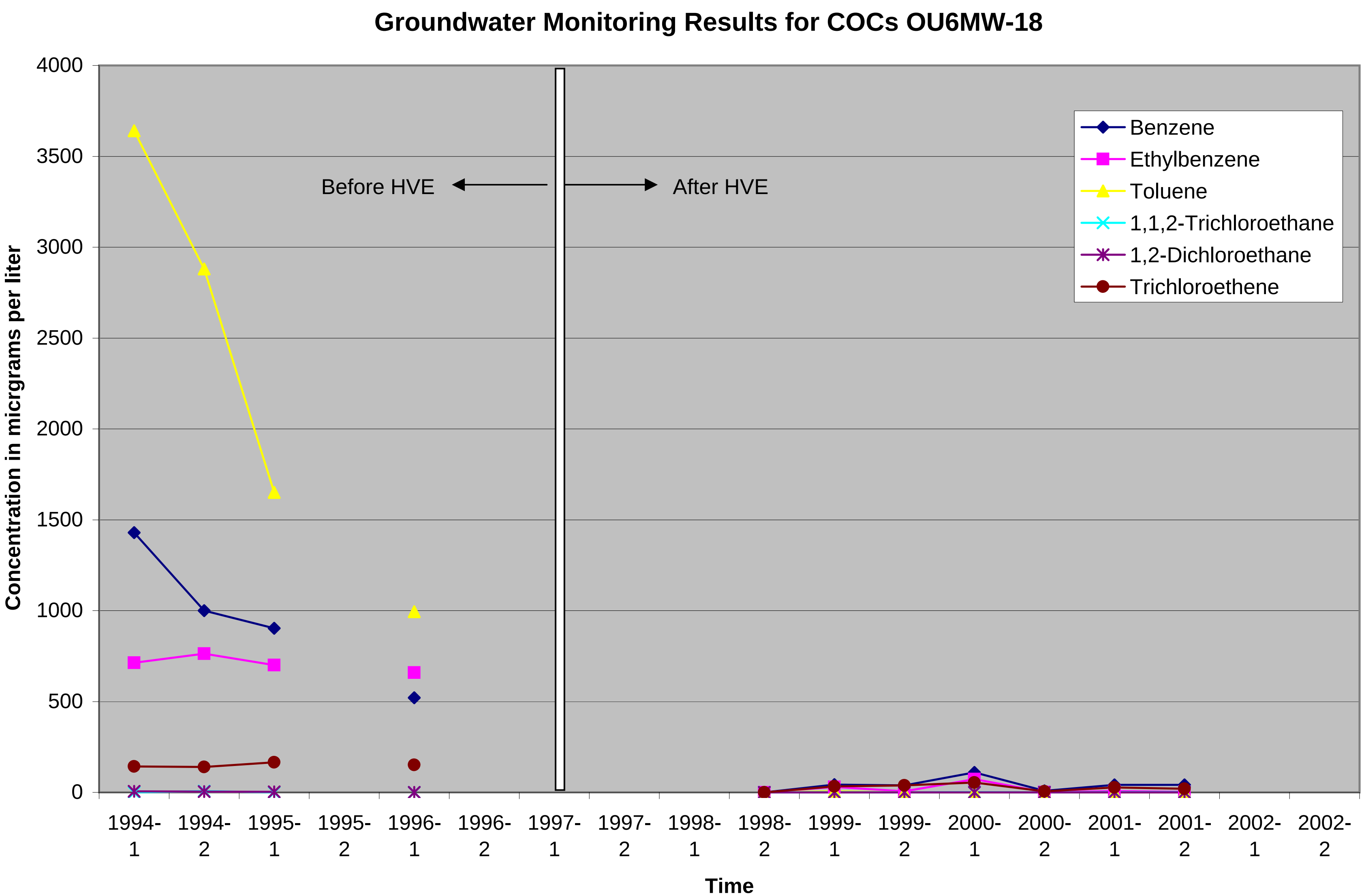


Figure 3-3



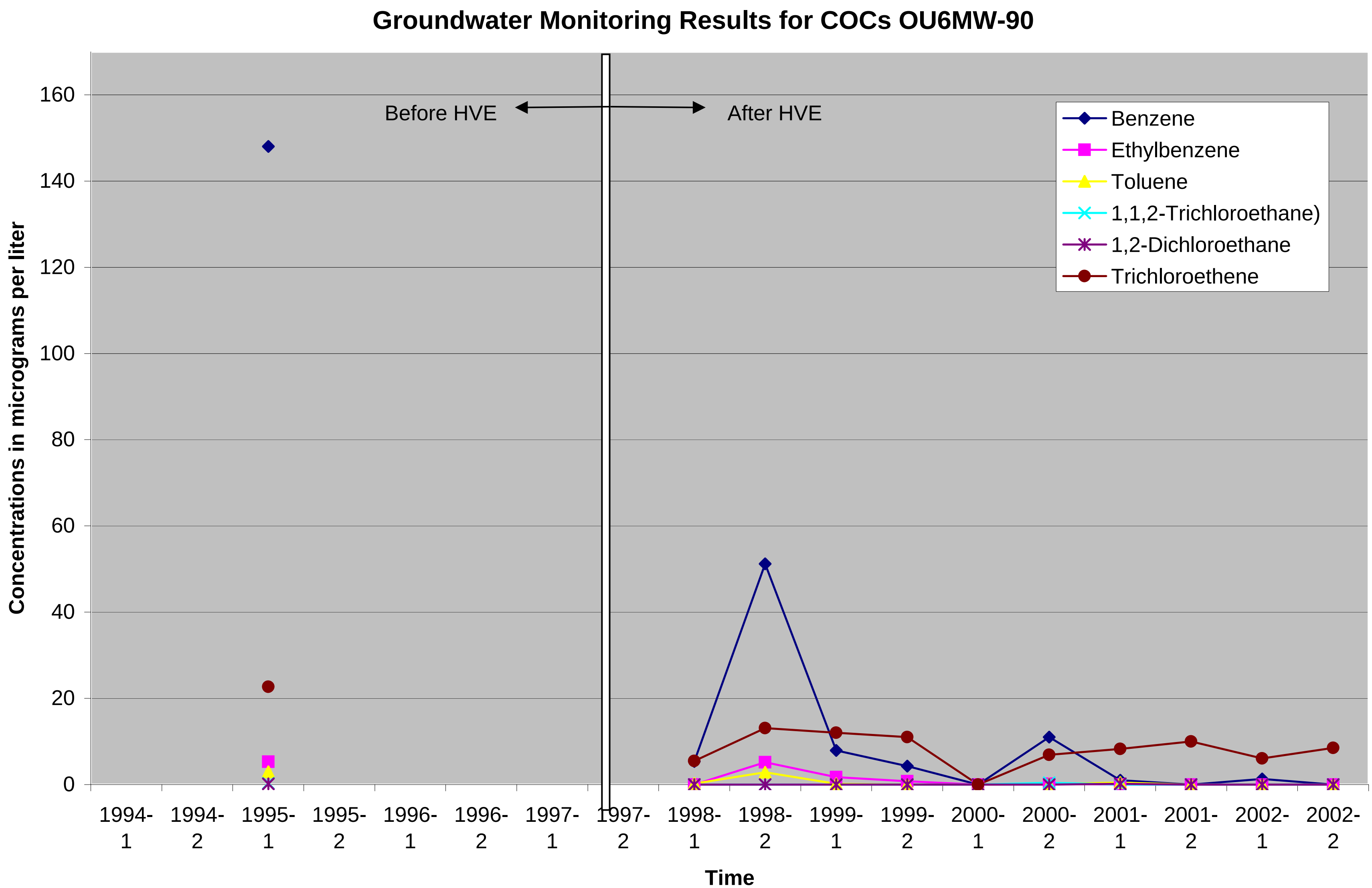
Groundwater Monitoring Results for COCs OU6MW-17
Concentrations in micrograms per liter
240
220
200
180
160
140
120
100
80
60
40
20
0
Before HVE
After HVE
Benzene
Ethylbenzene
Toluene
1,1,2-Trichloroethane)
1,2-Dichloroethane
Trichloroethene
1994-1
1994-2
1995-1
1995-2
1996-1
1996-2
1997-1
1997-2
1998-1
1998-2
1999-1
1999-2
2000-1
2000-2
2001-1
2001-2
2002-1
2002-2
Time

Figure 3-4



Groundwater Monitoring Results for COCs OU6MW-18
Concentration in micrgrams per liter
4000
3500
3000
2500
2000
1500
1000
500
0
Before HVE
After HVE
Benzene
Ethylbenzene
Toluene
1,1,2-Trichloroethane
1,2-Dichloroethane
Trichloroethene
1994-1
1994-2
1995-1
1995-2
1996-1
1996-2
1997-1
1997-2
1998-1
1998-2
1999-1
1999-2
2000-1
2000-2
2001-1
2001-2
2002-1
2002-2
Time

Figure 3-5


Groundwater Monitoring Results for COCs OU6MW-90
Concentrations in micrograms per liter
160
140
120
100
80
60
40
20
0
Before HVE
After HVE
Benzene
Ethylbenzene
Toluene
1,1,2-Trichloroethane)
1,2-Dichloroethane
Trichloroethene
1994-1
1994-2
1995-1
1995-2
1996-1
1996-2
1997-1
1997-2
1998-1
1998-2
1999-1
1999-2
2000-1
2000-2
2001-1
2001-2
2002-1
2002-2
Time

4.0 OPERATIONS AND MAINTENANCE

This section describes the O&M tasks performed in 2003. These tasks derived from the *2002 SD15 HVE System Annual Technical Report* (USAF, 2003) and the *SD15 HVE System Operation and Maintenance Manual (USAF, 1997)*.

In addition, O&M tasks included waste management and disposal of waste oil, oil soaked pads, carbon vessel carbon, oil/water separator media, and other waste produced during the operation and maintenance of the system. These will be included in the non-routine maintenance items. Waste management procedures were described in the previously submitted Field Sampling Plan. Maintenance also included response to system alarm conditions. Since June 2003, there have been approximately 60 system shutdowns. These shutdowns are addressed below.

Lastly, the HVE system was modified in 2003 to incorporate SVE at locations of known shallow soil contamination and optimized accordingly. The new system configuration is described below and shown on Figure 1-2.

4.1 SUMMARY OF CURRENT O&M COSTS

Annual O&M cost include planning and management, scheduled and unscheduled system maintenance, monitoring, and reporting. Associated O&M costs for operation of the SD15 HVE/SVE system are presented in Table 4-1. Costs are presented for fiscal year (FY) 2000, FY 2001, FY 2002, and FY 2003 to help establish means for monitoring annual costs.

4.2 SYSTEM SHUTDOWNS

There were 61 shutdowns of the HVE system during the nine-month period from June 2003 through March 2004. Table 4-2 contains a brief synopsis of these shutdowns. Fifty-four of these 61 automatic shutdowns occurred between 1 June 2003 and 15 December 2003. Twenty-nine of these 54 automatic shutdowns (54%) are noted as occurring for no apparent reason. The HVE system has many sensors, which monitor the operating parameters and will automatically shut down the HVE system should the system not be in the acceptable operating range. However, each of these sensors is also connected to an indicator light that is illuminated when the sensor shuts down the system. A shut down for no apparent reason means that none of the indicator lights were illuminated after the system had shut down, and the system would restart when the start button was pushed. After several of these shutdowns for no apparent reason, each of the sensing circuits was checked to ensure that it would keep the proper indicator light illuminated after it shut down the system. Each of the sensor circuits was tested by temporarily altering the wiring in the control panel, and each operated properly. An electrician could not identify the cause of these frequent shutdowns but suggested that this could be the result of voltage fluctuations in the electrical lines supplying power to the HVE. This was considered, however the operator had concluded that the frequent system shutdowns during the summer of 2002 were not the result of voltage fluctuations. The HVE system was overhauled during the winter of 2002-2003 and after this overhaul the frequent shutdowns for no apparent reason halted for several months. This lead to the conclusion that voltage fluctuations had not caused the previous frequent shutdowns. An Infrastructure Survey Report on the HVE system conducted in April 2003 also concluded that voltage fluctuations were not the cause of the frequent shutdowns.

In mid-December 2003 the soft-starter for the main motor on the HVE system failed. A different electrician visited the site and noted that the electrical drawings for the HVE had not been updated as changes were made to it. He noted that a non-recording voltage monitor had been installed in the control panel but was not noted on the drawings. This voltage monitor would shutdown the HVE system for voltage fluctuations; however, the voltage monitor was not connected to an indicator light so there would not be any indication of why the system had shutdown. A new recording voltage monitor was installed in the system which will indicate if it shutdown the system and the specific problem (voltage fluctuation, single-phasing, etc.) that occurred.

If the HVE system continues to shutdown frequently for no apparent reason despite the addition of the new voltage monitor, the wiring for each of the sensor circuits should be traced from the control panel to the sensor itself to ensure that each of the sensors is properly wired and that the sensor cannot shutdown the system yet not illuminate the proper indicator light. If the new voltage monitor shuts down the system repeatedly, the power supplying the pole-mounted transformers that step-down the power supplied to the system and the output power from these transformers should be monitored. If the power to and from these transformers is does not fluctuate, the underground cables, which bring the power from the transformers to the HVE building should be checked.

Table 4-1 Annual O&M Costs SD15 HVE/SVE System

Task Number	Task	Description	Annual Subtotal FY 2000 [a]	Annual Subtotal FY 2001 [b]	Annual Subtotal FY 2002 [c]	Annual Subtotal FY 2003 [d]
1	Planning	Planning Labor	$11,000.00	$11,878.00	$9,762.00	$14,842.22
			$11,000.00	**$11,878.00**	**$9,762.00**	**$14,842.22**
2	Fieldwork	Operations Labor		$10,278.00	$9,100.00	
	HVE	Maintenance Labor		$10,723.38	$33,900.00	$21,741.81
		Monitoring Labor		$6,029.76	$14,517.00	
		Supplies		$2,184.00	$26,025.00	$11,770.94
		Waste Mngmt.		$500.00	$1,400.00	$2,875.25
			$61,000.00	**$29,715.14**	**$84,942.00**	**$36,388.00**
3	Reporting	Prepare reports	$40,000.00	$42,827.79	$40,630.00	$35,818.70
			$40,000.00	**$42,827.79**	**$40,630.00**	**$35,818.70**
4	Analytical Costs	Water-GRO		$161.00	$200.00	$127.56
	HVE	Water-DRO		$195.00	$150.00	$127.56
		Water-VOC		$1,702.00	$966.00	$1,558.18
		Vapor-AVO/HVOC		$2,610.00	$1,920	$2,867.14
		Vapor-C5-C10		$1,350.00	$1,000.00	$1,314.35
		Vapor-C1-C4		$1,200.00	$915.00	$1,817.72
		Soil-DRO		NS	$2,300.00	NS
		Soil-GRO		NS	$2,285.00	NS
		Soil-BTEX		NS	$525.00	NS
		Labor		$3,076.00	$6,500.00	$3,196.04
					Total HVE	$11,008.55
	Analytical Costs	Vapor-AVO/HVOC				$955.71
	SVE	Vapor-C5-C10				$438.12
		Vapor-C1-C4				$605.91
		Labor				$1,065.35
					Total SVE	$3,065.08
			$19,000.00	**$10,294.50**	**$16,761.00**	**$14,073.63**
5	Management [e]		$18,000.00	$30,711.00	$22,000.00	$25,765.77
			$18,000.00	**$30,711.00**	**$22,000.00**	**$25,765.77**
Total Annual O&M Costs			**$149,000.00**	**$125,426.43**	**$174,077.00**	**$126,888.32**

[a] – Presented expenditures are estimated from April 2000 through March 2001.
[b] – Presented expenditures are estimated cost of O&M activities conducted from April 2001 through March 2002.
[c] – Increased fieldwork costs in 2002 can be attributed to a number of system shutdowns and maintenance activities.
[d] – Presented expenditures are estimated cost of O&M activities conducted from April 2003 through March 2004.
[e] – Expenditures associated with proposal preparation and cost estimate submittal are included under the management task.
AVO – aromatic volatile organic
BTEX – benzene, toluene, ethylbenzene, and xylene
DRO – diesel range organic
FY – fiscal year
GRO – gasoline range organic
HVOC – halogenated volatile organic compound
NS – not sampled in 2001
VOC – volatile organic compound

Table 4-2 Operating Problems at SD 15

6/16/2003	Monday	No indications of problem.
6/30/2003	Monday	No indications of problem.
7/1/2003	Tuesday	No indications of problem.
7/12/2003	Saturday AM	No indications of problem.
7/14/2003	Monday 7:15 AM	No indications of problem.
7/18/2003	Friday AM	No indications of problem.
7/22/2003	Tuesday AM	No indications of problem.
7/30/2003	Wednesday 0430	No indications of problem.
8/1/2003	Friday 0820	Breaker in PB2 for the HVE skid opened.
8/1/2003	Friday 2130	No indications of problem.
8/6/2003	Wednesday 1615	No indications of problem.
8/6/2003	Wednesday 1731	No indications of problem.
8/7/2003	Thursday 1400	No indications of problem.
8/8/2003	Friday 1730	Breaker in PB2 for the HVE skid opened.
8/11/2003	Monday 1630	Broken plastic pipe in water treatment unit put water on floor.
8/14/2003	Thursday 1900	System back up with flexible couplings in treatment skid lines to avoid breaks from vibration and fatigue of plastic piping.
8/20/2003	Wednesday 0650	No indications of problem.
8/20/2003	Wednesday 1620	No indications of problem.
8/23/2003	Saturday 2100	Breaker in PB2 for the HVE skid opened.
8/27/2003	Wednesday 0030	No indications of problem.
8/29/2003	Friday 1320	Breaker in PB2 for the HVE skid opened.
9/1/2003	Monday 0415	No indications of problem.
9/4/2003	Thursday 1000	Breaker in PB2 for the HVE skid opened.
9/5/2002	Friday 1230	No indications of problem.
9/9/2003	Tuesday 0330	No indications of problem.
9/12/2003	Friday 0600	No indications of problem.
9/12/2003	Friday 1230	No indications of problem.
9/14/2003	Sunday 0430	No indications of problem.
9/17/2003	Wednesday 0200	No indications of problem. Vacuum overload light came on when trying to restart system. System eventually restarted.
9/17/2003	Wednesday 1330	No indications of problem. Vacuum overload light came on and system would not restart. Getting electrician to check system.
9/25/2003	Thursday 1400	System back operational. Electrician could not find any problems but system restarted.

9/27/2003	Saturday 1130	No indications of problem. System left down so oil would be cool for semiannual maintenance due on Monday 29 Sep.
9/30/2003	Tuesday 1600	System back operational. Semiannual completed
9/30/2003	Tuesday 2230	System down. Apparently the bag filters on the water treatment skid were leaking after the semiannual maintenance was completed.
10/1/2003	Wednesday 1030	System back up.
10/7/2003	Tuesday 1730	No indications of problem.
10/9/2003	Thursday 0330	No indications of problem.
10/11/2003	Saturday 2230	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/16/2003	Thursday 0630	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/18/2003	Saturday 1000	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/22/2003	Wednesday 2300	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/24/2003	Friday 0600	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/26/2003	Sunday	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/28/2003	Tuesday 0130	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/29/2003	Wednesday 0615	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
10/31/2003	Friday 0200	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
11/1/2003	Saturday 0930	Low oil light illuminated. Oil level OK when arrived at site. System restarted without additional oil.
11/3/2003	Monday 1600	New low oil switch installed.
11/18/2003	Tues 1400	Broke sight glass in the "suck-back" line
12/5/2003	Friday 1600	New sight glass installed and system back up
12/6/2003	Saturday 1300	System down. May have been low oil from improperly adjusted just installed needle valve.
12/8/2003	Monday 1300	System up
12/8/2003	Monday 1800	System down. No indications of problem.
12/15/2003	Monday 1200	System down. No indications of problem. System would not restart - Soft Starter damaged.
1/16/2004	Friday AM	Main 125 amp breaker outside of building opened at some time even though main motor not on. Heaters on separate circuit still operating.
1/22/2004	Thursday AM	Voice call out on open circuit. When arrived all power (heat and motor) back on but had been off and temp down to below alarm point.
2/11/2004	Wednesday 1400	System up. New soft starter, surge-suppressor, and fault indicating voltage monitor installed
2/12/2004	Time unknown	Main 125 amp breaker outside of building opened at some time. UPS on phone not operating so there was no call out.
2/12/2004	Thursday 1800	System down for leak in contaminated water line from HVE skid to the water treatment skid.
2/13/2004	Friday 1830	System down. Motor Saver indicated system went down because one of the phases temporarily lost.
3/22/2004	Monday 1230	Main HVE breaker opened. No indication why on Motor Saver.

4.3 MAINTENANCE TASKS

Maintenance tasks performed in 2003 are listed in Table 4-3. All tasks were performed in accordance with the *SD15 High-Vacuum Extraction System Operation and Maintenance Manual, Final. (USAF, 1997b).*

Table 4-3 Maintenance Tasks Performed June – December 2003

Frequency [1]	Task Planned	Completion or Deviation From Plan
Monthly	Clean basket strainer on HVE inlet separator twice per month	Monitored, did not require cleaning
	Drain spooge from the condensate collection vessel	Monitored, did not require draining
	Replace bag filters twice a month or more if necessary	Completed
	Grease vacuum pump and motor	Completed
	Clean out water flow totalizer	Monitored, did not require cleaning
6 Months	Clean or Change basket strainers	Completed
	Flush and drain the HVE inlet separator	Monitored, did not require flushing or draining
	Clean Y-strainer on seal oil recirculation system	Completed
	Clean or replace stained "sight glass" sections	Completed
	Clean inlet separator level switches	Monitored, did not require cleaning
	Perform scheduled oil change	Completed
	Clean cooling fins on aftercooler	Completed
	Change belts (2)	Monitored, did not require replacing
	Waste management	Completed
1 Year	Clean the O/W separator and both process tanks in the HVE skid	Not completed, not enough water processed
	Check rooftop condensate trap	Not completed, will complete in Spring 2004
	Clean condensate knock out and float trap assembly	Not completed, will complete in Spring 2004
	Drain and flush aftercooler	Cleaned cooling fins on aftercooler
	Replace D-cell batteries in autodialer cell phone	Completed
Non-routine	Replace two carbon vessels – carbon only	Only one vessel required replacing
	Dispose of drum of oil-soaked pads	Completed
	Change seal oil	Completed
	Change stained clear PVC pipe	Completed
	Incidental snow removal after plowing	Completed
	Repaired wells at 1301 and 1302 Installed flexible tubing on transfer pump	Completed Completed

1 The frequency of above tasks may be reduced due to planned system shutdown to accommodate groundwater and soil sampling events, system optimization, and the incorporation of any system modifications.
HVE – high-vacuum extraction
SVE – soil vapor extraction
O/W – oil/water
PVC – polyvinyl chloride

4.4 MODIFICATIONS TO HVE SYSTEM

Four soil vapor extraction wells were installed as part of the SD015 project for 2003. Two of these wells were installed around EHVE02-SB19C (by existing well W-1303), and two around EHVE02-SB03C (by the HVE Process Building). The modified system configuration is shown on Figure 1-2.

Based on the contamination found in the borings and the guidance in *Soil Vapor Extraction and Bioventing* (EM 1110-1-4001, June 2002) the wells were installed according to the specifications given in the following table. (NOTE EM 1110-1-4001 recommends the top of the screen for an HVE well be located 1.5 meters below grade.)

Table 4-4 SVE Well Installation Data

Site	Depth	Screen Length	Screened Interval
EHVE02-SB19C	13 ft bgs	8 ft	5-13 ft bgs
EHVE02-SB03C	10 ft bgs	5 ft	5-10 ft bgs

Each of the wells is assumed to have a 30 ft radius of influence so the radii of influence of the two wells in each pair overlap.

According to the *2002 SD 15 HVE System Annual Technical Report* (March 2003) the HVE wells at W-1303 and W-1304 have reached their soil cleanup goals and no longer need to be operated. The SVE wells around EHVE02-SB19C (by existing well W-1303) were located approximately 200 feet from the HVE Process Building. These two SVE wells were connected to the existing two-inch diameter vacuum line currently running to well W-1303. The two wells around EHVE02-SB03C (by the HVE Process Building) were run directly to the HVE building and connected to the HVE system inside the building. Vapor sampling of the SVE wells will be conducted on a quarterly basis to document the performance of this system modification.

4.5 OUT-YEAR O&M COSTS

Rough order-of-magnitude costs associated with operations and maintenance, monitoring, and optimization tasks recommended for FY 2004 through FY 2006 are presented in Table 4-5. Activities presented in the multi-year planning summary apply exclusively to fieldwork tasks and analytical costs. Items identified as planning, reporting, and management tasks are not presented.

Table 4-5 Multi-Year Planning Summary

Task	FY 2004	FY 2005	FY 2006
OPERATION AND MAINTENANCE			
Routine	$34,000	$36,000	$38,000
Non-Routine			
Replace carbon in one carbon vessels	$1,450	$1,500	$1,550
Replace O/W separator media	$550	$575	$600
Purchase and install bag filters	$450	$475	$500
Oil changes (two total, including shipping)	$2,000	$2,050	$2,100
Change out belts (two sets)	$250	$250	$250
Replace fuses and relays	$525	$525	$575
Disposal costs after cleaning aftercooler and vessels	$750	$750	$800
Disposal of one drum of oil and one drum of sorbents	$400	$425	$450
Replace viton stator in groundwater transfer pump	$275	$300	$325
General maintenance costs (includes miscellaneous piping, valves, tubing, sorbents, gaskets, hardware, light bulbs, hoses, etc.)	$1,000	$1,050	$1,100
Replace oil separator media	$1,000	$1,050	$1,100
Vacuum pump repair (includes seals, gaskets and bearings)	$2,000	--	--
MONITORING			
HVE System Monitoring	$11,500	$12,000	$12,500
Close-out sampling event (includes mandatory three-year sampling of shallow soils and groundwater sampling event)	--	$5,000	--
SVE System Monitoring	$4,000	$4,200	$4,400
Close-out sampling event (First event scheduled for FY2007 to include mandatory three-year sampling of shallow soils and groundwater sampling event)	--	--	$5,000
SYSTEM OPTIMIZATION MODIFICATIONS			
Design modifications to allow SVE in shallow soils near former boring locations SB19 and E7-SB-03 by tying into existing SVE piping	--	--	--
Construction and implementation of shallow soil SVE system modifications	--	--	--
Update Operations and Maintenance Manual to reflect current system maintenance requirements and system modifications	--	--	--

* A viton stator is currently in inventory as a replacement.
FY – fiscal year HVE – high-vacuum extraction
O/W – oil/water

4.5 SYSTEM OPTIMIZATION

Four new SVE wells were installed in 2003. The vacuum and air flow generated by the HVE pump must be optimally split between the SVE wells and the two HVE wells which remain operational. The SVE wells operate most efficiently when they have maximum air flow. However, the air flow from the HVE wells must be adequate to allow them to continue to entrain groundwater in their air flow. Further complicating this, the air resistance of the soil that all the wells draw air through change with freeze depth. During 2004 the air flows between the HVE and SVE wells will be adjusted during the seasons to determine the optimal split over time.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

The following subsections summarize the results of seven years of HVE operation. This information includes a summary of contaminant removal, progress towards meeting remediation goals, and recommendations for system optimization, O&M, and monitoring activities.

5.1 SUMMARY OF CONTAMINANT REMOVAL

During the time interval from January 1 - December 31, 2003, the HVE system was operational approximately 60 percent of the time. Downtime was primarily due to equipment failures that required unscheduled maintenance. The system was also shutdown for regularly scheduled maintenance. In general system malfunctions continue to compromise overall system effectiveness. Suggestions for diagnosing the cause of the unexpected system shutdowns and improving operational performance are given below in Section 5.4.

Water, vapor, and soil data have been collected during the seven years of HVE system operation to continually assess the system's performance. The operating parameters, the mass of contamination removed from the subsurface at SD15, and cost per pound of contaminant removed are summarized in Table 5-1. A comparison of 1997 - 2003 data clearly show the system is reaching a point of diminishing returns and, as expected, the removal rate of contaminants is decreasing as the site is remediated. This results in a significant increase in the cost per pound of contamination removed.

Table 5-1 Contaminant Removal Summary

Parameter	Year 1 (1997)	Year 2 (1998)	Year 3 (1999)	Year 4 (2000)	Year 5 (2001)[1]	Year 6 (2002)	Year 7 (2003)	Totals
Contaminant Removal								
Hours operated	7,040	5,466	5,821	1,859	4,721.50	2,291.70	5,222	32,420
Volume of groundwater extracted (gal.)	56,600	87,146	54,349	48,655	62,984	11,520	53,870	375,124
Mass of volatile organic compounds removed through liquid phase (pounds)	>0.2	6.45	0.52	0.01	0.0184	0.0005	0.0033	7.378
Mass of volatile organic compounds removed through vapor phase (pounds)	7,543	1,060	797	413	220	53	6.24	10,092
Estimated Cost per Pound of Contamination Removed								
Cost per pound for labor	$8.00	$33.56	$53.77	$115.41	$224.54	$1,392.06	$6,542.28	--
Cost per pound for materials, supplies, and laboratory	$4.50	$20.38	$62.88	$119.31	$89.92	$709.43	$3,457.01	--
Cost per pound for project management	$3.05	$10.83	$37.31	$55.22	$84.25	$293.02	$4,126.95	--
Cost per pound for electricity[2]	$5.19	$16.54	$16.54	$16.54	$16.54	$16.54	$16.54	--
Total cost per pound of contamination removed	$20.73	$81.30	$170.50	$306.48	$415.25	$2,411.05	$14,142.78	--

[1] - 2001 costs include total estimated costs for the project, because the period of performance was not entirely complete.

[2] - Data assume costs as reported from 1998 data, but assumed biased low.

[3] – Costs are biased high due to additional tasks completed in 2002 (five-year sampling event). Plus higher than expected materials costs for non-routine maintenance.

5.2 PERFORMANCE GOALS

The HVE system operated 5,222 hours during 2003. The system operated 65.0% of time for the year not including June for which no operating hours were recorded do to a change in the system's operators. This is lower than the performance goal of 75%, however, this is the most hours of operation since 1999. The HVE system like most complicated mechanical systems periodically has major problems that shut it down for several weeks while repair parts are obtained and installed. For example the system only operated 77 hours in December (10.3%) because the soft starter failed on the 15th and was not operational again until 16 January. In addition to the major breakdowns, the HVE system also had 54 automatic shutdowns between 1 June and 15 December 2003. These shutdowns are discussed in Section 4.2. These have been attributed to a voltage monitor that was added to the control panel for the HVE skid but this addition was not documented. This problem has been corrected by a new voltage monitor that records the cause when it shuts down the system. Correcting this problem should increase the operating rate of the system for the coming year.

As noted in Table 5-1 the cost to remove a pound of contamination increased by a factor of almost six over the previous year's cost. This is due to the dramatic decrease in pounds of contaminant removed despite an increase in the hours the system operated during the year. The addition of the SVE wells to the system in 2004 should dramatically increase the pounds of contaminant removed and correspondingly decrease the removal cost per pound.

5.3 PROGRESS TOWARDS REMEDIATION

The following subsections summarize status of remedial progress in groundwater, shallow soils, and deep soils at SD15.

5.3.1 Groundwater

Monitoring wells in the vicinity of SD15 provide the best indication as to whether or not groundwater is being effectively remediated by this system. Contamination above remediation goals is present at W-1301 (OU6MW-17), W-1302 (OU6MW-90), and OU6MW-18. A review of data provided in Table 2-2 indicates that only benzene and TCE remain above remediation goals in W-1301 (OU6MW-17) and in the most recent sampling data for OU6MW-18. Only TCE currently exceeds remediation goals at W-1302 (OU6MW-90). No other COCs remain above remediation goals. Prior to system installation, almost a foot of free product was measured on top of the water table at OU6MW-18. The system has effectively removed this product and no free product has been noted since 1998. In general, COC's have been reduced by at least an order of magnitude since SD15 began operation. OU6MW-17 and OU6MW-90 show similar reductions in dissolved phase contaminants, though an increase in benzene concentration over the last two sampling rounds at OU6MW-17 needs to be monitored closely.

5.3.2 Shallow Soil

Contamination still remains at two distinct locations at the site. One of these is in an area just south of the HVE Process Building near former sampling locations SB74, SB75, and E7-SB-03 (see Section 2.2.2). Contamination remaining in this area was verified with the June 2002 sample EHVE02-SB03C. At this location, GRO slightly exceeds the remediation goal. All other COCs at this locality are below remediation goals. The other area of shallow soil contamination exists near HVE Well W-1303 near former sampling locations SB19, SS03, SB76, and SB77. Contamination remaining in this area was verified with the June 2002 samples EHVE02-SB19C and EHVE02-1303C. The analytical data suggest that high-volatility COCs such as GRO and BTEX remain in the shallow soil medium and should be effectively treated by the newly installed SVE wells.

The newly installed SVE wells came online in February 2003. At this time there is insufficient data to estimate the timeframe of cleanup of COC in shallow soils in these areas. As more data is collected and a decrease in COCs becomes evident, an estimate of cleanup timeframe will be constructed.

5.3.3 Deep Soil

Closure sampling was performed at HVE Wells W-1302, W-1303, and W-1304 to document the effectiveness of HVE at treating deep soils and to guide future operational modifications to the system. This sampling is described in Section 2.2.3. Sampling at these locations demonstrated remediation was complete at HVE Well W-1302 (also referred to as OU6MW-90) and at HVE Well W-1304. Deep soil samples at HVE Well W-1303 were all well below cleanup goals with the exception of the 9-11 foot bgs interval. Although this contamination is technically in “deep” soils, it is relatively shallow and in the same vicinity as documented shallow soil contamination.

5.4 RECOMMENDATIONS

Table 5-2 provides a list of recommendations for the 2004 operation of the HVE system at SD15.

Table 5-2 Recommendations for FY 2004

Task	Purpose/Comments
Experiment with vacuum pressures to balance flows between the two HVE and four SVE wells and modify O&M Manual.	The system has experienced a number of shut downs in the past when the extraction wells have been flooded by incoming groundwater indicating that not enough vacuum is being pulled on the well. The SVE wells will require an optimal level of vacuum to maximize volatilization but minimize short circuiting from the surface. Balancing these requirements will optimize the operating system and will be an iterative process that should ultimately result in a set of operating parameters to include in a revised O&M Manual. It is also expected that balanced air flows will eliminate vacuum induced temperature drops that currently contribute to icing in the extraction piping.
Monitor system shutdowns with the Motor-Saver voltage monitor and record results.	Single phasing has been indicated as a possible explanation for the repeated system shutdowns. Tracking of the incoming power excursions will allow troubleshooting up the line at a later date.
Install smaller granular activated carbon (GAC) canisters and increase frequency of change out.	Clogging of the GAC systems by silt has caused an increase in back-pressure that has forced replacement of GAC that was still effective. Using smaller GAC canisters will result in more complete canister usage before silt clogging occurs, which will reduce cost and therefore optimize the system.
Repair outside electrical box.	The electrical box suffered damage as a result of a snowplow accident. It was temporarily repaired but requires additional work in the spring to meet electrical code and reliability requirements. The system's electrical drawings should be updated to accurately reflect their current state.
Increase oil changes to semi-annually.	The O&M manual currently calls for oil changes when "the oil is dark in color." This is a very subjective criteria and oil color is not a reliable indicator of its condition. Increasing the oil changes will enhance the operating efficiency of the system.
Thoroughly inspect all plumbing, gauges, and electrical connections. Update system drawings.	As the system ages, failures of fittings and valves can be expected to increase. A focused inspection can identify suspect components and allow for a planned replacement.

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