Massachusetts Military Reservation

Decision Document
Study Area CS-8/FS-21

Final
October 2000

Prepared for:
AFCEE/MMR
Installation Restoration Program
322 E. Inner Road
Otis ANGB, MA 02542
DSN: 557-4670 Comm: 508-968-4670

Prepared by:
HARDING ESE

Submitted by:
Advanced Infrastructure Management Technologies
Oak Ridge, Tennessee 37831-7606
Managed by:
LOCKHEED MARTIN ENERGY SYSTEMS for the
U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

Harding ESE
A MACTEC COMPANY

Harding ESE, Inc.
P.O. Box 7050
Portland, ME 04112-7050

Telephone: 207/775-5401
Fax: 207/772-4762
Home Page: www.mactec.com

December 6, 2000

Mr. Robert M. Gill
Remediation Program Manager
HQ AFCEE/MMR
322 East Inner Road
Otis ANG Base, MA 02542-5028

Subject: CS-8/FS-21 Decision Document
Massachusetts Military Reservation

Dear Mr. Gill:

For the Air Force Center for Environmental Excellence, and as directed by Advanced Infrastructure Management Technologies, Harding ESE is hereby submitting copies of the Final Decision Document for Study Area CS-8/FS-21. This final deliverable includes the executed signature pages provided under HQ AFCEE/MMR transmittal letter dated November 28, 2000.

Please contact me at (207) 775-5401 if you have any questions.

Sincerely,

Harding ESE, Inc.

John W Peterson

John W. Peterson
MMR Project Manager

Enclosures (16 bound, 1 unbound, 1 digital)

cc: P. Marchessault, USEPA (2 bound)
J. Murphy, USEPA (letter only)
L. Pinaud, MADEP (2 bound)
E. Grillo, MADEP (letter only)
M. Maly, SFIM-AEC-IRP (1 bound)
J. Watson, NGB-ARE (1 bound)
L. Luemh, CC Johnson & Molhotral/ETA (1 bound)
D. Jacobson, Camp Edwards Environmental Office (1 bound)
F. Crowner, AIMTech (1 bound, 1 unbound, 1 digital)
A. Piecuch, Harding ESE (1 bound, 1 digital)
J. Peters, Harding ESE (1 bound)
File

INSTALLATION RESTORATION PROGRAM

DECISION DOCUMENT
STUDY AREAS CS-8/FS-21
OPERATIONAL MOTOR POOL,
OMS-22/CURRENT PRODUCT TANK NO. 90

FINAL
OCTOBER 2000

Prepared for:
Air Force Center for Environmental Excellence and
Air National Guard

Prepared by:
HARDING ESE
Portland, Maine
Project No. 49240

Advanced Infrastructure Management Technologies
Oak Ridge, Tennessee 37831-7606

Managed by:
LOCKHEED MARTIN ENERGY SYSTEMS
for the
U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

DECISION DOCUMENT
STUDY AREAS CS-8/FS-21

TABLE OF CONTENTS

Section	Title	Page No.
EXECUTIVE SUMMARY		ES-1
1.0 INTRODUCTION		1-1
2.0 STUDY AREAS DESCRIPTION AND HISTORY		2-1
2.1 STUDY AREA CS-8		2-1
2.2 STUDY AREA FS-21		2-3
2.3 TASK 6 RECORDS SEARCH		2-3
3.0 SUMMARY OF STUDY AREAS INVESTIGATIONS		3-1
3.1 METAL-DETECTOR SURVEY		3-4
3.2 SOIL-GAS SURVEY		3-4
3.3 TEST-PIT PROGRAM		3-7
3.4 SOIL BORINGS AND MONITORING WELLS		3-9
3.5 TERRAPROBE BORINGS		3-10
3.6 GEOLOGY		3-11
3.7 HYDROGEOLOGY		3-12
4.0 CONTAMINATION ASSESSMENT		4-1
4.1 SURFACE SOIL		4-1
4.2 SUBSURFACE SOIL		4-3
4.3 GROUNDWATER		4-8
5.0 PRELIMINARY RISK EVALUATION		5-1
5.1 INTRODUCTION		5-1
5.1.1 Approach		5-1
5.1.2 Study Areas CS-8/FS-21 Objectives		5-2
5.2 HUMAN-HEALTH PRELIMINARY RISK EVALUATION		5-2
5.2.1 Data Evaluation		5-3
5.2.2 Contaminants of Potential Concern		5-8
5.2.3 Cumulative Receptor Risks		5-9
5.2.3.1 Calculation of CPC Exposure Point Concentrations		5-9
5.2.3.2 Calculation of Receptor CPC Intakes		5-10
5.2.3.3 Quantification of CPC Toxicity		5-12
5.2.3.4 Calculation of Cancer and Noncancer Risks		5-12
5.2.4 Uncertainty Assessment		5-19
5.3 ECOLOGICAL PRELIMINARY RISK EVALUATION		5-20
5.3.1 Data Evaluation		5-20
5.3.2 Ecological Exposure Assessment		5-20

DECISION DOCUMENT
STUDY AREAS CS-8/FS-21

TABLE OF CONTENTS

Section	Title	Page No.
5.3.3	Ecological Effects Assessments	5-21
5.3.4	Risk Screening	5-21
5.3.5	Ecological Uncertainty Assessment	5-23
5.4	SUMMARY OF PRELIMINARY RISK EVALUATION RESULTS	5-24
6.0	DRAINAGE STRUCTURE REMOVAL ACTIVITIES	6-1
7.0	SUMMARY AND CONCLUSIONS	7-1
8.0	DECISION	8-1

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

REFERENCES

APPENDICES

APPENDIX A	SUMMARY OF CLP ANALYTICAL DATA
APPENDIX B	SUMMARY OF FIELD LABORATORY ANALYTICAL DATA FOR TERRAPROBE BORINGS
APPENDIX C	UNDERGROUND STORAGE TANK REMOVAL DETAILS
APPENDIX D	DRAINAGE STRUCTURE O4CDXX1 CLOSURE REPORT

DECISION DOCUMENT
STUDY AREAS CS-8/FS-21

LIST OF FIGURES

Figure	Title	Page No.
2-1	MMR Site Map	2-2
2-2	Study Areas CS-8/FS-21 Map	2-4
3-1	Study Areas CS-8/FS-21 Interpretive Soil-Gas Map with Contours, Total Halocarbons	3-5
3-2	Study Areas CS-8/FS-21 Interpretive Soil-Gas Map, Total Hydrocarbons	3-6
3-3	Exploration Locations at Study Areas CS-8/FS-21	3-8
4-1	Study Areas CS-8/FS-21 Interpretive Groundwater Analytical Results	4-11

LIST OF TABLES

Table	Title	Page No.
3-1	CLP Analytical Sampling Program	3-2
4-1	Summary of Analytes Detected in Surface Soil - Off-Site Analysis	4-2
4-2a	Summary of Analytes Detected in Subsurface Soil - Off-Site Analysis	4-4
4-2b	Summary of Analytes Detected in Soil - On-Site Analysis	4-6
4-3	Summary of Analytes Detected in Groundwater - Off-Site Analysis	4-10
5-1	Contaminants of Potential Concern in Surface Soil	5-5
5-2	Contaminants of Potential Concern in Subsurface Soil (2-10' bgs)	5-6
5-3	Contaminants of Potential Concern in Groundwater	5-7
5-4	Exposure Parameters - Resident	5-11
5-5	Incidental Ingestion of and Dermal Contact With Surface Soil - RME - Adult Resident	5-13
5-6	Inhalation Exposure to Particulates in Surface Soil - RME - Adult Resident	5-14
5-7	Incidental Ingestion of and Dermal Contact With Surface Soil - RME - Child Resident	5-15
5-8	Inhalation Exposure to Particulates in Surface Soil - RME - Child Resident	5-16
5-9	Ingestion of and Dermal Contact With Groundwater - RME	5-17
5-10	Risk Summary Table - Potential Future Land Use	5-18
5-11	Ecological Contaminants of Potential Concern in Surface Soil	5-22

EXECUTIVE SUMMARY

As part of the preliminary assessment conducted in 1986 for the Installation Restoration Program at the Massachusetts Military Reservation, Study Area CS-8 (Operational Motor Pool, OSM-22), and adjoining Study Area FS-21 (Current Product Tank No. 90), were identified as potential sites of past uncontrolled disposal of hazardous substances. Because of this finding, contamination in these areas was investigated and characterized during two site inspection programs (1988, 1989), a drainage structure removal program (1996), underground storage tank removals (1996, 1999), and additional groundwater sampling (1999). This Decision Document provides a summary of these activities, an assessment of the contaminants detected, and a preliminary risk evaluation.

Potential contaminant sources for the CS-8/FS-21 Study Areas consisted of:

- Vehicle maintenance wastes prior to 1970.
- Battery electrolyte disposed of in an on-site cesspool from 1970 to 1985.
- A former 12,500-gallon underground storage tank used to store diesel fuel.
- The former location of Current Product Tank No. 90, a 5,000-gallon underground storage tank used to store motor vehicle gasoline.

The deposition of these potential contaminant sources is as follows:

- Wastes generated at CS-8 are now transported to the Army's 3500 Area at the MMR for temporary storage prior to shipment off-site to a licensed Treatment, Storage, and Disposal Facility.
- The cesspool was removed in 1996 during the Drainage Structure Removal Program. Clean closure was achieved.
- 12,500-gallon underground storage tank used to store diesel fuel was removed in 1988 and replaced with a new double wall tank. Pressure testing of the original tank in 1985 indicated it to be tight (i.e., no leaks). This new tank was removed in 1998 and not replaced. Soil contamination during underground storage tank excavations was not detected.
- A leak test conducted on Current Product Tank No. 90 (5,000-gallon tank) in 1985 was inconclusive due to a bent fill pipe. The tank was removed in 1988 and replaced with a double wall tank of the same capacity, west of the vehicle repair shop. This new tank was later removed in 1996. Soil contamination during underground storage tank excavations was not detected.

Results from the human health and ecological preliminary risk evaluation suggest that unacceptable levels of risk are not anticipated. Therefore, the Air Force Center for Environmental Excellence recommends no further action for Study Areas CS-8 and FS-21 via this Decision Document.

1.0 INTRODUCTION

The objectives of this decision document are to (1) describe the histories of the Operational Motor Pool, OMS-22 (Study Area CS-8), and the Current Product Tank No. 90 (Study Area FS-21) at the Massachusetts Military Reservation (MMR); (2) present results of site characterization investigations at Study Areas Chemical Spill (CS)-8/Fuel Spill (FS) FS-21; (3) present results of human health and ecological preliminary risk evaluations (PREs); and (4) explain why no further action is recommended for these study areas. Study Areas CS-8/FS-21 initially were identified in the Task 6 records search, a preliminary assessment (PA) of MMR conducted as part of the U.S. Department of Defense Installation Restoration Program (IRP) (E. C. Jordan Co., 1986).

The IRP is a program at military facilities to identify, evaluate, and remediate waste-disposal and spill sites that were contaminated through past practices. Study Areas CS-8/FS-21 were investigated further in the Tasks 2-3A and 2-3C site investigations (SIs) (E. C. Jordan Co., 1989a and 1990b).

In 1988, Current Product Tank No. 90 (5,000-gallon motor vehicle gasoline [MOGAS] underground storage tank [UST]), and a 12,500-gallon Diesel-fuel UST were replaced at the study areas with two double-walled USTs of the same size, and storing the same petroleum product (5,000-gallon MOGAS, 12,500-gallon Diesel fuel). The 5,000-gallon UST and the 12,500-gallon UST were removed in 1996 and 1999, respectively. In 1996, a cesspool was also removed from the study area as part of the Drainage Structure Removal Program.

In 1999, confirmational sampling was conducted to confirm the finding that no additional remedial actions were required.

2.0 STUDY AREAS DESCRIPTION AND HISTORY

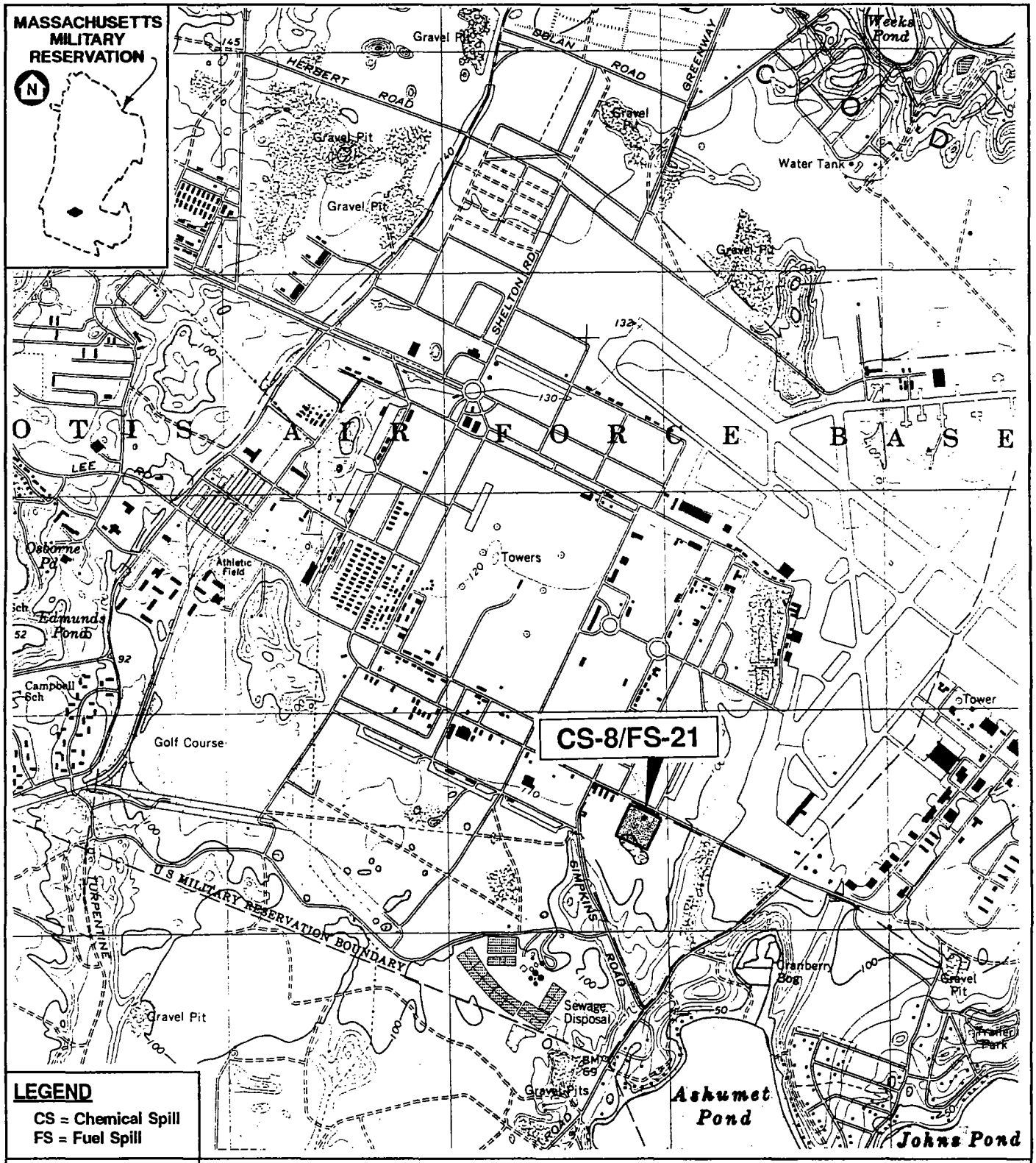
Study Areas CS-8/FS-21 are located next to each other along the south-central boundary (Figure 2-1). Because of this geographical proximity, Study Areas CS-8/FS-21 were combined for purposes of SI field activities.

2.1 Study Area CS-8

Study Area CS-8 includes an active and an abandoned concrete wash pad, a cesspool, and a 12,500-gallon diesel-fuel UST and pump island located west of the Vehicle Repair Shop. The study area has been operating as the current Army National Guard Vehicle Repair Shop at MMR since 1950. The maintenance shop has been responsible for the maintenance of from 20 vehicles (1950) to 300 vehicles (1986). In November 1998, maintenance operations at the Study Area were shifted to the Unit Training Equipment Storage (UTES) site off Greenway Road. Minimal maintenance activities still occur at the Study Area by reservists during weekend activities.

Summary of Waste Management Practices: Since 1970, all vehicle maintenance wastes, except used battery electrolyte, have been disposed of off-site through a hazardous-waste contractor. Until 1985, battery electrolyte had been discharged to the cesspool. No records exist regarding pre- 1970 waste-disposal practices. It is likely that before 1970, wastes either were taken to the base landfill or dumped onto the ground at the study area. Reportedly up to 250 gallons per year (gal/yr) of waste oil (mixed with solvents), 20 gal/yr of paint thinner, and 50 gal/yr of waste solvents were generated by vehicle-maintenance activities before 1970 (E. C. Jordan Co., 1989a). Degreasing agents likely included halogenated solvents such as TCE and DCE, and petroleum distillates. The quantities actually disposed of on-site are unknown. Until November 1998, wastes generated at Study Area CS-8 were drummed, sent to Building 4600 for temporary storage, prior to shipment off-site to a licensed Treatment, Storage, and Disposal Facility (TSDF). Currently, wastes generated at Study Area CS-8 are transported to the Army's 3500 Area at the MMR for temporary storage, prior to shipment off-site to a TSDF.

Cesspool: Details of the original volume and design of the cesspool are not available, nor is it known if it was connected to a leachfield. Upon its removal in 1996, the cesspool was observed to have been constructed of concrete barrel block walls, with an open dirt bottom



Harding Lawson Associates
Engineering and Environmental Services

MMR SITE MAP

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

DECISION DOCUMENT

FIGURE 2-1

07620-41

ten feet below grade surface, and a 4-inch-diameter ceramic inlet pipe with no outlet pipe. The walls had previously collapsed (Jacobs, 1996).

12,500-Gallon Diesel Fuel UST: The 12,500-gallon diesel-fuel UST at Study Area CS-8 was pressure-tested in May 1985 and found to be tight. In 1988, this tank was removed and replaced with a double-walled tank of the same capacity at the same location (Pesce and Berube, 1990). During removal of the tank in 1988, no contaminated soil was encountered (Berube, 1990). In 1998, this new 12,500-gallon diesel-fuel tank was removed and not replaced. See Appendix C for details on the 1998 UST removal. Although documentation of the 1988 removal is based on verbal conversation, and not written documentation, the location of the 1998 and 1988 removals were in the same location, and no contamination was detected within the 1998 UST excavation.

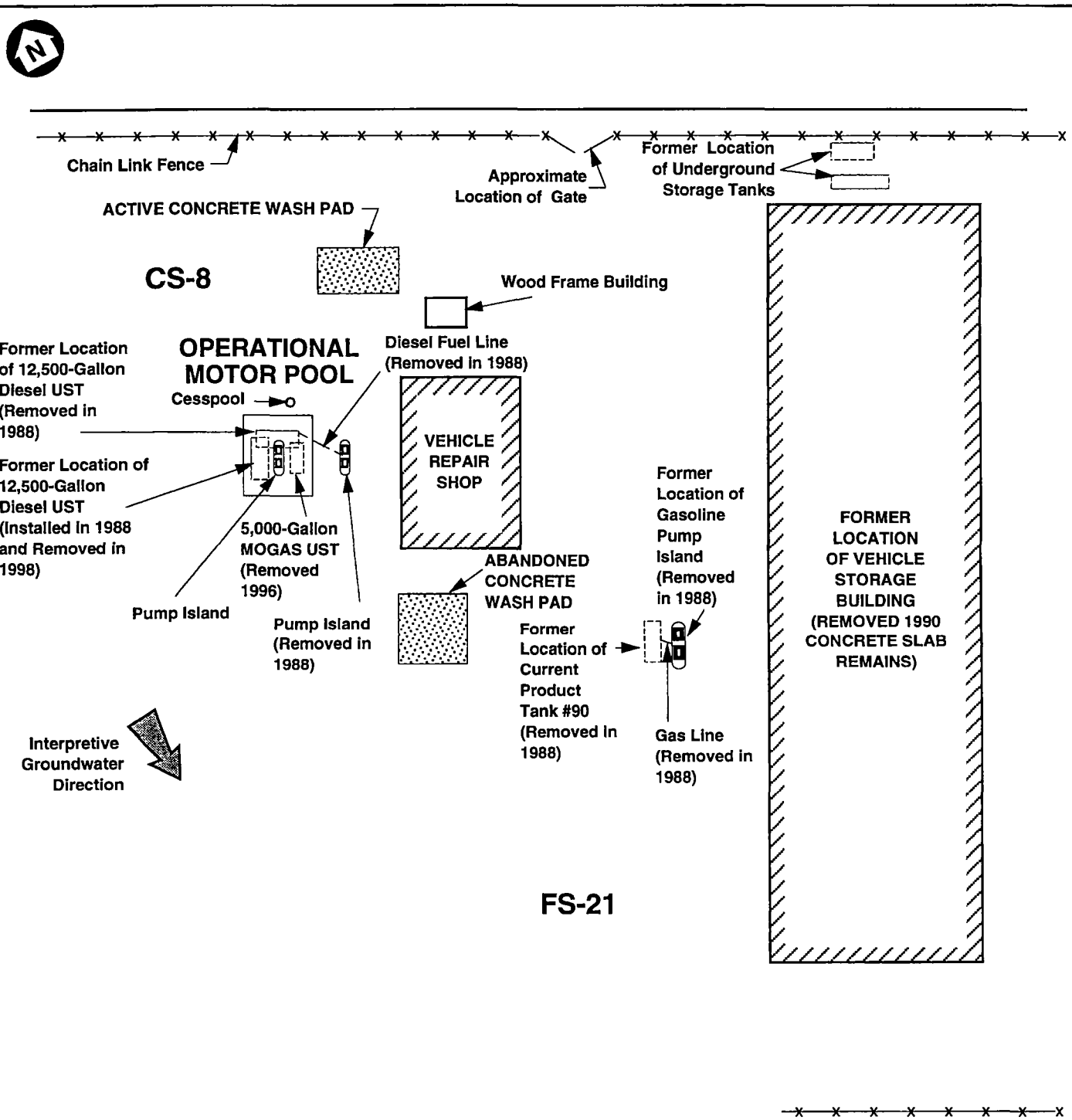
2.2 Study Area FS-21

Study Area FS-21, southwest of the Vehicle Repair Shop, is the former location of Current Product Tank No. 90, a 5,000-gallon MOGAS UST installed in 1954 (Figure 2-2). Study Area FS-21 also includes the former location of two USTs at the northern end of the Vehicle Storage Building. Details concerning the size, construction, and former use of the two USTs are not available.

Current Product Tank No. 90: This tank was pressure-tested in May 1985 to assess potential leakage, but the test was inconclusive because of a bent fill pipe. In 1988, the tank was removed and replaced with a double-walled MOGAS tank of the same capacity, installed west of the Vehicle Repair Shop, and adjacent to the 12,500 gallon diesel-fuel UST (Pesce and Berube, 1990) (see Figure 2-2). At the time of the removal of Current Product Tank No. 90 in 1988, the associated piping and gasoline pump island were removed and the area was re-graded. No contamination was noted in the surrounding soil, which is consistent with the interpretation of investigation results (Pesce and Berube, 1990). The new 5,000-gallon UST was subsequently removed in 1996. See Appendix C for details on the 1996 UST removal.

2.3 Task 6 Records Search

Potential contaminants identified in the Task 6 Records Search were waste solvents and oils, battery electrolyte, and MOGAS. The primary constituents of MOGAS are hydrocarbons. Study Areas CS-8 and FS-21 were assigned Hazard Assessment Rating Methodology (HARM) ratings of 66.6 and 61.9, respectively. The HARM system is



NOTE:

GROUNDWATER DIRECTION FROM MARCH 1988 DATA (E.C. JORDAN CO., 1989a).

UST = UNDERGROUND STORAGE TANKS

SCALE IN FEET

0 50 100

Harding Lawson Associates Engineering and Environmental Services	STUDY AREAS CS-8/FS-21 MAP	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	DECISION DOCUMENT	FIGURE 2-2

9905003D G

designed to prioritize sites at an installation to indicate the relative need for a SI. HARM considers factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. Based on findings of the Task 6 Records Search, Study Areas CS-8 and FS-21 were recommended for SI studies.

Historically, a chain-link fence enclosed Study Areas CS-8/FS-21. In the late 1980s, the fence was temporarily opened along the southern boundary for site improvements, including grading of the vehicle parking area. The fence has not been reinstalled along the southern boundary.

3.0 SUMMARY OF STUDY AREAS INVESTIGATIONS

The SI field program for Study Areas CS-8/FS-21 was designed to evaluate whether past maintenance activities, waste-disposal methods, and a potentially leaking gasoline UST (i.e., Current Product Tank No. 90) affected soil and groundwater quality.

Task 2-3A SI: This 1987 investigation consisted of a metal-detector survey, a soil-gas survey, excavation of 10 test pits, completion of six soil borings with installation of monitoring wells in four of the borings, field gas chromatograph (GC) screening of soil samples, and laboratory analysis of soil and groundwater samples. Selected samples were submitted to a U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) laboratory and analyzed for selected Target Compound List (TCL) and Target Analyte List (TAL) chemicals. Table 3-1 lists the specific analyses for each sample.

Task 2-3C SI: This 1989 investigation was intended to resample groundwater from the existing study-area monitoring wells and sample contents of the on-site cesspool. However, only one of the four on-site wells was sampled (CS8/MW2). Wells CS8/MW1 and FS21/MW2 had been destroyed, and well FS21/MWI had been damaged (PVC riser was bent slightly) during previous site construction activities designed to improve surface-water drainage. The exact location of the cesspool could not be determined at the time of the investigation, because of newly graded gravel.

Laboratory analytical data from Tasks 2-3A and 2-3C are USEPA CLP data. Although the data were not validated according to USEPA functional guidelines or USEPA Region I guidelines, they were evaluated for holding times and the presence of blank contamination during preparation of this report and for suitability for use in risk assessments and to support engineering studies. Results of this data evaluation are in Appendix A and as discussed in this evaluation, the data were found suitable. Lack of full validation likely adds conservatism to the characterization of site conditions, because full validation could result in rejection of a maximum concentration that otherwise would have been used in the contamination assessment and PRE. Additional details concerning data-quality evaluation are in the Tasks 2-3A and 2-3C reports.

Phase I Sump Removal Program: In 1992, four TerraProbe borings were completed in the cesspool area to further evaluate the presence of contamination as part of the Phase I

TABLE 3-1
CLP ANALYTICAL SAMPLING PROGRAM

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

	SOIL SAMPLES						WATER SAMPLES						
EXPLORATION ID	SAMPLE DATE	DEPTH (feet bgs)	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Inorg.	SAMPLE DATE	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Inorg.	EDB MTBE	TPH
FS-21/TB-1	9/1/87	13-15	Y	N	N	N							
		18-20	Y	N	N	N							
		28-30	Y	Y	Y	Y							
		33-35	Y	N	N	N							
		63-65	Y	Y	Y	Y							
		63-65 (dup)	Y	Y	Y	Y							
FS-21/MW-1	9/1/87	52-62 (screen)	--	--	--	--	10/28/87	Y	Y	N	Y	N	N
							3/10/99	Y	N	N	Y	Y	N
FS-21/TB-2	9/9/87	0-2	Y	Y	Y	Y							
		10-12	Y	Y	Y	Y							
		39-41	Y	N	N	N							
		59-61	Y	Y	Y	Y							
FS-21/MW-2	9/9/87	51-66 (screen)	--	--	--	--	1/7/88	N	Y	N	Y	N	N
CS-8/TP-1	8/29/87	1-2	Y	Y	Y	Y							
CS-8/TP-6	8/31/87	5-6	Y	Y	Y	Y							
CS-8/TB-1	8/30/87	23-25	Y	Y	Y	Y							
		43-45	Y	Y	Y	Y							
		43-45 (dup)	Y	Y	Y	Y							
		58-60	Y	Y	Y	Y							
CS-8/TB-2	8/31/87	19-21	Y	Y	Y	Y							
		54-56	Y	Y	Y	Y							

continued

TABLE 3-1
CLP ANALYTICAL SAMPLING PROGRAM

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

	SOIL SAMPLES						WATER SAMPLES						
EXPLORATION ID	SAMPLE DATE	DEPTH (feet bgs)	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Inorg.	SAMPLE DATE	TCL VOC	TCL SVOC	TCL Pest/PCB	TAL Inorg.	EDB MTBE	TPH
CS-8/TB-2	8/31/87	54-56 (dup)	Y	Y	Y	Y							
CS-8/MW-2	8/31/87	52-62 (screen)	–	–	–	–	1/7/88	Y	Y	N	Y	N	N
							1/7/88 (dup)	Y	Y	N	Y	N	Y
							6/28/89	Y	Y	N	Y	N	Y
							6/28/89(dup)	Y	Y	N	Y	N	Y
							3/10/99	Y	N	N	Y	Y	N
							3/10/99(dup)	Y	N	N	Y	Y	N
CS-8/TB-3	8/31/87	8-10	Y	N	N	N							
		18-20	Y	Y	Y	Y							
		58-60	Y	Y	Y	Y							
CS-8/TB-4	9/1/87	0-2	Y	N	N	N							
		5-7	Y	N	N	N							
		8-10	Y	N	N	N							
		10-12	Y	Y	Y	Y							
		34-36	Y	Y	Y	Y							
		54-56	Y	Y	Y	Y							
CS-8/MW-4	9/1/87	52-62 (screen)	–	–	–	–	10/28/87	Y	Y	N	Y	N	N
							10/28/87 (dup)	Y	Y	N	Y	N	N
04BH0001	12/14/99	35-40	–	–	–	–	12/14/99	Y	Y	N	Y	Y	N

Notes:

TCL	=	Target Compound List	CLP	=	Contract Laboratory Program	Y	= sample analyzed for parameter
TAL	=	Target Analyte List	MW	=	monitoring well	N	= sample not analyzed for parameter
VOCs	=	volatile organic compounds	TB	=	test boring	screen	= well-screen interval
SVOCs	=	semivolatile organic compounds	TP	=	test pit	dup	= duplicate sample
PCBs	=	polychlorinated biphenyls	TPH	=	total petroleum hydrocarbons		

sump removal program with field GC screening of the soil samples collected (ABB Environmental Services, Inc. [ABB-ES], 1992a).

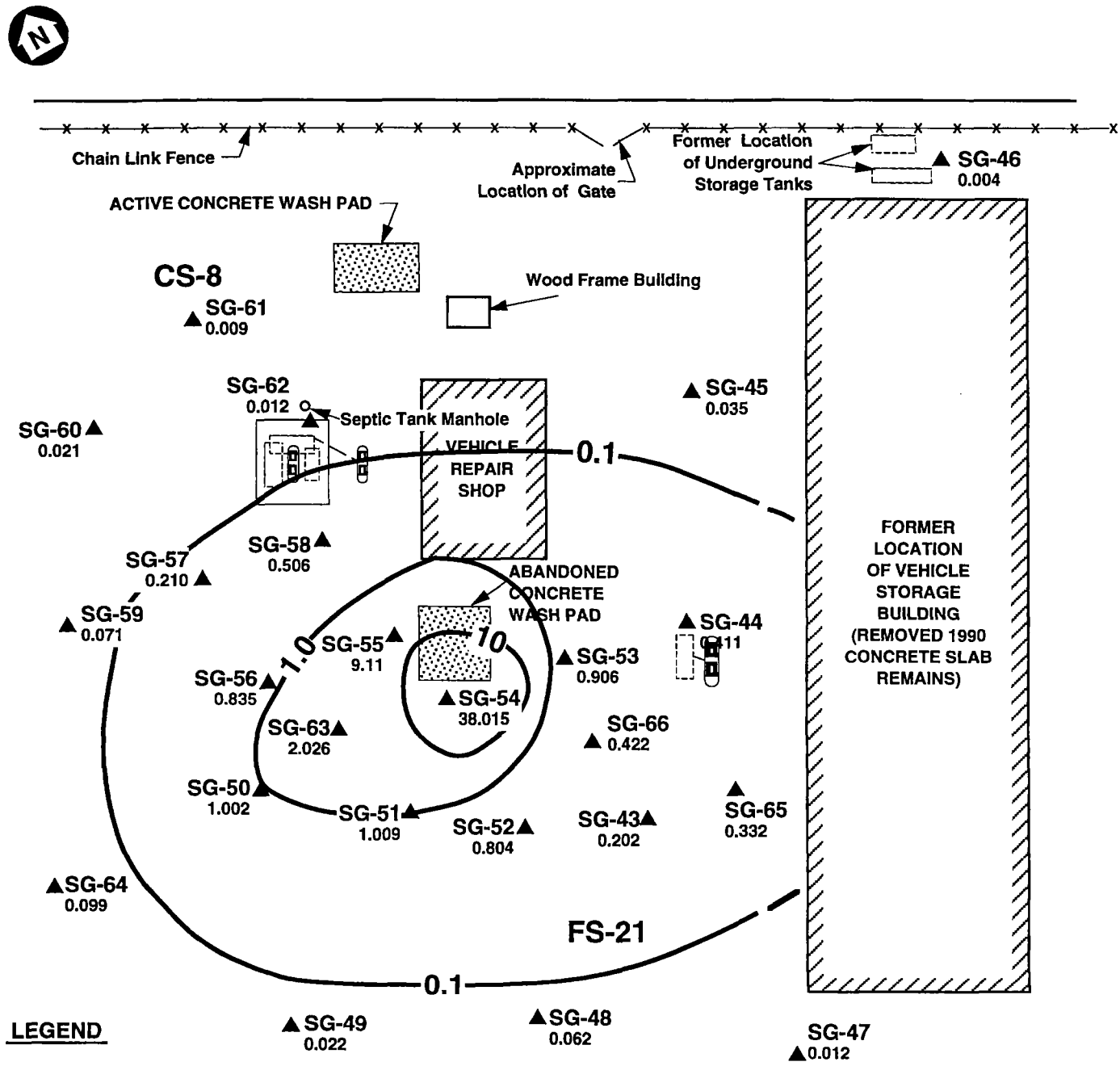
Confirmational Groundwater Sampling: In March 1999, monitoring wells CS8/MW2 and FS21/MW1 were resampled using the low flow purge technique. Monitoring well FS21/MW1, which couldn't be sampled during the Task 2-3C Site Investigation due to a bent riser, was accessed with a submersible pump. Groundwater samples were analyzed off-site for inorganics, and VOCs including methyl-tert-butyl ether (MTBE) and ethylene dibromide (EDB). In December 1999, a groundwater sample (Sample I.D. 04BH0001) was collected using the USEPA Region One's low flow purge and sample technique, at the top of the groundwater table from a borehole advanced at the former location of FS-21/MW-2. The groundwater sample was analyzed for VOCs, SVOCs, EDB, and inorganics.

3.1 METAL-DETECTOR SURVEY

A metal-detector survey was conducted at Study Areas CS-8/FS-21 on August 26, 1987, to locate USTs and underground fuel and utility lines so that invasive work would be done in areas likely to show contamination, while avoiding underground structures. Field procedures consisted of traverses spaced at intervals of 10 feet or less. The survey located the manhole cover of the cesspool and the diesel-fuel UST (see Figure 2-2). The supply line from the tank to the diesel pump island could not be located.

3.2 SOIL-GAS SURVEY

To assist in locating test pits and borings, a soil-gas survey was conducted on August 27 and 28, 1987, in areas considered likely to have received fuel or solvent spills and leakage. These areas included the abandoned wash pad, abandoned and active UST sites, and cesspool. Probes were completed in 24 locations to approximately 4 feet below ground surface (bgs) (Figure 3-1). Target analytes included trichloroethene (TCE), tetrachloroethene (PCE), trichloroethane, chloroform benzene, toluene, xylenes, and total non-methane hydrocarbons. All probes detected at least trace amounts of halocarbons, with the highest concentrations detected along the southern edge of the abandoned concrete wash pad, south of the Vehicle Repair Shop. The suspected source of these detections is minor spills of runoff from mechanical parts that had been cleaned with solvents. Halocarbon concentrations generally decreased with distance from the abandoned wash pad. Only two soil-gas probes detected the presence of hydrocarbons: The highest concentration was adjacent to the cesspool north of the diesel pump island (690 micrograms per liter [µg/L] headspace); the second highest concentration was 2 µg/L headspace, approximately I 00 feet south of the diesel pump island (Figure 3-2).



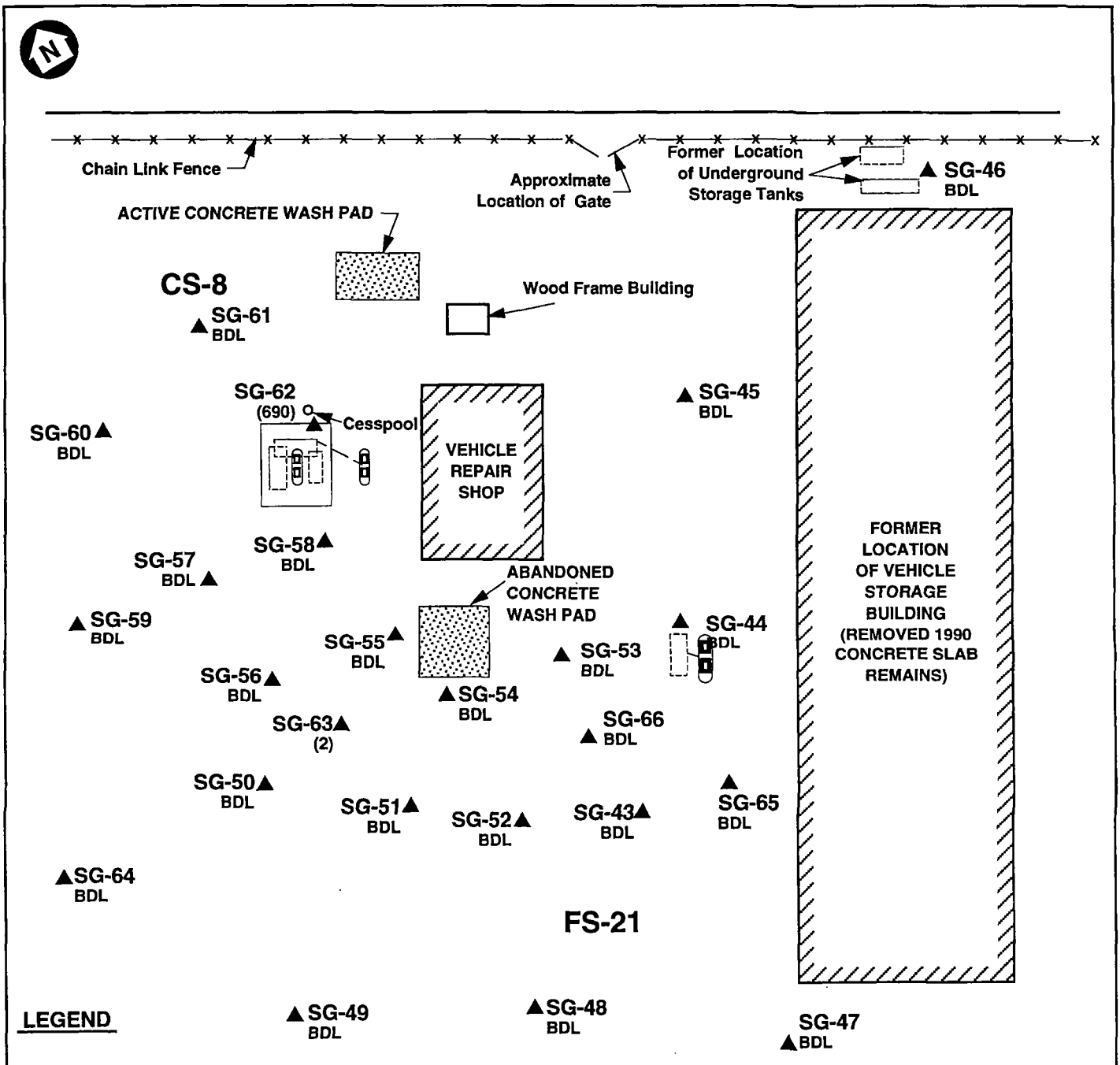
NOTES:

1. PRINCIPAL HALOCARBON DETECTED IS TETRACHLOROETHYLENE.
2. CONTOURS DRAWN FOR 0.1, 1.0, AND 10 µg/L TOTAL HALOCARBONS

SCALE IN FEET
0 50 100

Harding Lawson Associates Engineering and Environmental Services	STUDY AREAS CS-8/FS-21 INTERPRETIVE SOIL-GAS MAP WITH CONTOURS, TOTAL HALOCARBONS	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	DECISION DOCUMENT	FIGURE 3-1

9905003D F



NOTE:

1. SAMPLES SG-62 AND SG-63 CONTAINED ABUNDANT UNIDENTIFIED HYDROCARBONS IN THE SOIL GAS.

SCALE IN FEET

0 50 100

Harding Lawson Associates
Engineering and Environmental Services

STUDY AREAS CS-8/FS-21
INTERPRETIVE SOIL-GAS MAP,
TOTAL HYDROCARBONS

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

DECISION DOCUMENT

FIGURE 3-2

9905003D E

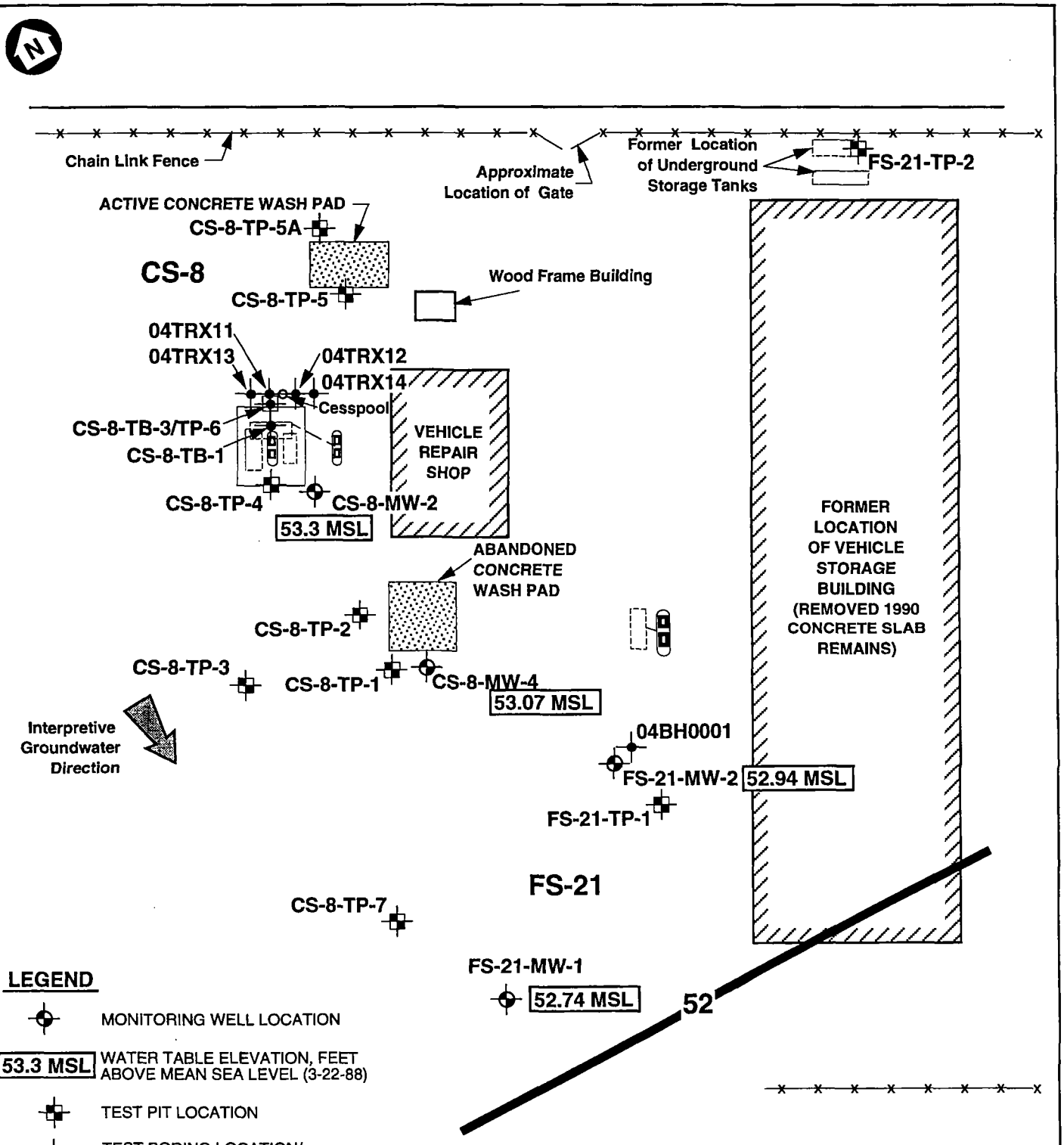
3.3 TEST-PIT PROGRAM

Ten test pits were excavated between August 29 and 31, 1987, to investigate shallow subsurface soil at suspected contaminant source locations. Logs for these test pits are in the Task 2-3A SI appendices (E. C. Jordan Co., 1989a).

Study Area FS-21: Two test pits were completed at Study Area FS-21 (Figure 3-3). Test pit FS-21/TP-1, located in the area of a geophysical anomaly approximately 50 feet south of the MOGAS pump island, was completed to a depth of approximately 7.5 feet bgs. During excavation, an iron pipe and a clay pipe were encountered; it was determined that neither pipe was in use. Soil surrounding these pipes at 3-5 feet bgs had photoionization (PI) readings at background levels and a soil sample just below the pipes was screened using a field GC; target VOCs were not detected. A 1981 utilities map for MMR does not specifically show pipes in the vicinity of FS-21 TP1. However, the map legend indicates that generally all building sanitary sewer connections were 6-inch diameter vituperative clay pipe, and all building water connections were 4-inch diameter cast iron, or 2.5-inch diameter wrought iron pipe. Given these diameters and piping materials, along with SI observations, these pipes were likely associated with water and/or sewer feeds to the Vehicle Storage Building.

The second test pit (FS-21/TP-2) was located at the former location of the USTs north of the Vehicle Storage Building to characterize shallow soil that may have been contaminated by spills or leaks from those tanks. During completion of both test pits, soil staining was not observed and PI meter readings were below background levels. Two soil samples (i.e., 5 and 7 feet bgs) from each test pit were screened with the field GC; target volatile organic compounds (VOCs) were not detected in any of the samples.

Study Area CS-8: Eight test pits (designated CS-8/TP-1 through CS-8/TP-7 and CS-8/TP-5A) were completed at Study Area CS-8 (see Figure 3-3); only one (i.e., CS8/TP-1) had PI meter readings above background levels. This test pit was located adjacent to the abandoned concrete wash pad and had PI meter readings of 13 parts per million (ppm). Eleven soil samples from the eight test pits were screened using a field GC; two VOC constituents were detected at trace concentrations. PCE was detected in CS-8/TP-1 (0.8 foot bgs) at a concentration of 1.1 micrograms per kilogram (µg/kg); benzene was detected in CS-8/TP-6 (5 feet bgs) at a concentration of 0.3 µg/kg. Two soil samples (CS8/TP-1, CS8/TP-6) were collected on the basis of field observations and submitted for off-site CLP analyses (see Table 3-1).



Harding Lawson Associates
Engineering and Environmental Services

EXPLORATION LOCATIONS AT STUDY AREAS CS-8/FS-21

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

DECISION DOCUMENT

FIGURE 3-3

9905003D D C H

3.4 SOIL BORINGS AND MONITORING WELLS

Six soil borings were completed and four monitoring wells were installed between August 30 and September 1, 1987. Four borings and two wells were positioned to investigate Study Area CS-8, and two borings and two wells were located to assess conditions at Study Area FS-21 (see Figure 3-3). Logs for these borings and wells are in the Task 2-3A SI appendices (E. C. Jordan, Co., 1989a). "CS-8/MW-2" and "CS-8/TB-2" are the designations for a monitoring well and test boring, respectively, completed in one location. If a test boring was completed but no monitoring well installed at a specific location, then a "TB" does not have a corresponding "MW".

A 2-foot-long split-spoon sample was collected from each boring at intervals from near the ground surface to the bottom of the boring. These samples were screened in the field by a PI meter and a subset of the samples was screened with the field GC. On the basis of PI meter readings and field GC results, the apparently most contaminated soil samples (a total of 23 different sample intervals) were submitted for off-site CLP analyses from the test borings completed at CS-8 and FS-21. The explorations IDs are listed in Table 3-1.

Study Area CS-8: At Study Area CS-8, two monitoring wells (CS-8/MW-2 and CS-8/MW-4) were installed to evaluate soil and groundwater quality. (Note that soil and groundwater samples are identified as TB and MW samples, respectively.) CS-8/MW-2 was positioned adjacent to the diesel pump island west of the Vehicle Repair Shop and downgradient of the cesspool. CS-8/MW-4 was positioned downgradient of the abandoned concrete wash pad. PI meter readings for the split spoon soil samples did not exceed background levels; however, several negative PI meter readings suggest that humidity may have reduced instrument sensitivity. No soil staining was observed during monitoring-well installation.

Field GC screening detected target VOCs in the soil boring samples. In CS-8/MW-2, trace concentrations (i.e., less than 1.5 μg/kg) of benzene and toluene were detected in subsurface soil samples over 29 feet bgs. In CS-8/MW-4, field GC screening detected up to 9.5 μg/kg of PCE at the ground surface, where PI meter readings of 6 to 8 ppm were recorded. The suspected source of these detections is minor spills of runoff from mechanical parts that had been cleaned with solvents. Trace concentrations of TCE and toluene also were detected in the surface soil. Both soil and groundwater samples were collected at these two locations and submitted for CLP analyses (see Table 3-1). CS-8/MW-2 was re-sampled in 1989 and 1999 for confirmational analyses (see Table 3-1).

Field GC screening also detected target VOCs in soil samples from the two borings in Study Area CS-8 in which wells were not installed (i.e., CS-8/TB-1 and CS-8/TB-3). In CS-8/TB-1, located adjacent to the 12,500-gallon diesel-fuel UST, field GC screening of most soil samples from 8 to 63 feet bgs detected trace concentrations of dichloroethene (DCE), TCE, PCE, benzene, and toluene. In CS-8/TB-3, located just south of the cesspool, benzene (up to 1.5 μg/kg), TCE (up to 0.6 μg/kg), and PCE (1.8 to 3.2 μg/kg) were detected from 53 to 58 feet bgs. Toluene was detected throughout the soil column in CS-8/-TB-3, with the highest concentration (4.1 μg/kg) at 8 feet bgs, where soil staining also was observed.

Study Area FS-21: Two monitoring wells were installed at Study Area FS-21 to evaluate potential soil and groundwater contamination. FS-21/MW-1 was positioned downgradient of the study area along the southern boundary; FS-21/MW-2 was installed adjacent to the former location of Current Product Tank No. 90.

During installation of FS-21/MW-1, elevated PI meter readings of 7 ppm were observed at 28 to 30 feet bgs; readings at other depths were at background levels. Ten soil samples were screened using the field GC; traces of benzene, TCE, and toluene were detected, primarily within the unsaturated soil (13-53' bgs). Soil staining was not observed.

During installation of FS-21/MW-2, PI meter readings of 6 to 17 ppm and a two-inch layer of black stained soil was observed in the surface sample at this location. Soil staining was encountered in surface soil. Fifteen soil samples screened with the field GC showed the presence of low concentrations of VOCs. Low concentrations of VOCs also were detected at the water table: TCE (11 μg/kg) and toluene (2.3 μg/kg).

Groundwater samples from these two monitoring wells were submitted for CLP analysis (see Table 3-1). In 1999, FS-21/MW-1 was re-sampled for confirmational analyses (see Table 3-1). In December 1999, a groundwater sample (Sample I.D. 04BH0001) was collected using the USEPA Region One's low flow purge and sample technique, at the top of the groundwater table from a borehole advanced at the former location of FS-21/MW-2. The groundwater sample was analyzed for VOCs, SVOCs, EDB, and inorganics.

3.5 TERRAPROBE BORINGS

Four TerraProbe borings (i.e., 04TRXI1, 04TRX12, 04TRX13, and 04TRX14) were completed in February 1992 as part of the Phase I Sump Removal Action in the cesspool area along a line approximately perpendicular to the western wall of the Vehicle Repair Shop. Approximate locations of the borings are shown in Figure 3-3. Soil samples were

collected for field laboratory analysis at 4, 8, 12, 18, and 24 feet bgs from each boring. Each sample was analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), inorganics, and total petroleum hydrocarbons (TPH). A summary of the results and their corresponding Tier I and Tier II hazard equivalent concentrations (HECs) are presented on Table 4-2b, and a summary of the on-site analytical results are included in Appendix B.

Review of the TerraProbe data shows that with one exception, detection of target VOCs, SVOCs, pesticides, and inorganics was limited to samples from boring 04TRX12 (4-12 feet bgs). Possible fuel-related VOCs, including toluene (130 μg/kg), ethylbenzene (190 μg/kg), m/p-xylene (6.1 and 250 μg/kg), and o-xylene (67 μg/kg), were reported in one sample from this boring, but not its duplicate. The inorganics copper (270 milligrams per kilogram [mg/kg]) and zinc (380 mg/kg) also were reported in the same sample, but not its duplicate. Two pesticides, delta-benzene hexachloride (D-BHC) (150 to 530 μg/kg) and heptachlor epoxide (140 to 1,800 μg/kg), were reported in samples from this boring. The VOC m/p-xylene (6.1 μg/kg) was reported in one sample from boring 04TRX14. TPH was detected in all samples at 40 to 980 mg/kg. TPH concentrations were apparently unrelated to both target analyte concentrations (except in samples from boring 04TRX12) and PI meter readings. SVOCs were not detected in any samples.

3.6 GEOLOGY

The geology of the study areas was interpreted from the test pits and test borings. The borings drilled at this site extended to depths of 65 to 66 feet bgs that is just below the water table.

Subsurface soil encountered was typical of outwash deposits found across the southern part of MMR. The soil was primarily poor- to well-graded, fine to medium sand, with trace amounts of coarse sand and fine gravel. In some locations, the top 1.4 feet of soil was fill over a thin, discontinuous ash layer. The ash was observed to be grey to black, loose to medium dense, and dry. The ash measured from 0.1 foot thick in FS21/TP1 to 0.7 feet thick in CS8/TP5. The typical study-area soil sample consisted of about 95 percent fine to medium sand, 5 percent fin gravel and coarse sand, and trace amounts of silt.

3.7 HYDROGEOLOGY

As interpreted from MMR-wide groundwater-elevation data, groundwater flows in a southerly direction in the vicinity of Study Areas CS-8/FS-21, toward the western portion of Study Area SD-1 and Ashumet Pond (E. C. Jordan Co., 1989b). Groundwater elevations at Study Areas CS-8/FS-21 on March 22, 1988, ranged from 52.7 to 53.3 feet above mean sea level (MSL), or approximately 58 feet bgs.

4.0 CONTAMINATION ASSESSMENT

In general, the contamination assessment of a site is based on CLP data and, to a lesser extent, field analytical data, depending on the methodologies and analyses performed. At Study Areas CS-8/FS-21, the field GC screening analytical data, in which concentrations were reported in micrograms per liter (μg/L) headspace, and the PI meter readings are considered qualitative only. The CLP analytical data, which quantify concentrations of TCL contaminants in soil and groundwater, are most useful for contamination assessment

4.1 SURFACE SOIL

Three surface-soil samples (zero to 2 feet bgs) were analyzed for CLP analytes (Table 4-1). TCL VOCs were not detected. Two TCL SVOCs, both phthalates, were detected at concentrations of less dm half their Contract Required Quantitation Limits (CRQLs) in one of two surface-soil samples. Phthalates would not be expected at Study Areas CS-8/FS-21 as a result of manufacturing- or process-related activities because such activities did not occur on-site. Because of their ubiquitous presence in plastics, phthalates are recognized by USEPA as common laboratory and sampling artifacts (USEPA, 1991). Given the low concentrations at which they were detected and their nature as common artifacts, the two phthalates are not considered site contaminants. The PCB Aroclor-1260 was detected at 660 μg/kg in one of two samples in which it was a target analyte. This single detection was in the sample collected adjacent to the abandoned wash pad. It is possible that very localized PCB contamination exists in this area and is related to some former activity at the abandoned wash pad. However, the measured concentration is below the clean-closure limit of 1,000 μg/kg set by USEPA (USEPA, 1989c), and PCB-containing equipment is not known to be present in the study areas.

In the two samples analyzed for TAL inorganics, only barium, copper, thallium, and zinc were detected at concentrations above MMR maximum background concentrations for surface soil (ABB-ES, 1992b). All four inorganics were detected at concentrations less than twice MMR maximum background concentrations.

TABLE 4-1
SUMMARY OF ANALYTES DETECTED IN SURFACE SOIL - OFF-SITE ANALYSIS

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

ANALYTES	"Exploration ID: "Sampled: "Depth:	Maximum Background Concentration (mg/kg)	FS-21/TB-2 10-SEPT-87 0	CS-8/TP-1 02-SEPT-87 1	CS-8/TB-4 04-SEPT-87 1
VOLATILE ORGANIC COMPOUNDS (µg/kg)			-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS (µg/kg)					
Bis(2-ethylhexyl)phthalate		NA	64J	-	NR
Butylbenzylphthalate		NA	140J	-	NR
Pesticides/PCBs (µg/kg)					
4,4'-DDT		NA	-	-	NR
Aroclor 1260		NA	-	660	NR
INORGANIC COMPOUNDS (mg/kg)					
Aluminum		8,930	3220	1300	NR
Arsenic		3.6	2.2	0.69J	NR
Barium		10.4	9.6J	11J	NR
Beryllium		0.65	-	0.37J	NR
Calcium		969	218J	331J	NR
Chromium		6.8	5.3	2.1J	NR
Cobalt		4.1	-	1.5J	NR
Copper		5.2	-	9.2J	NR
Iron		12,400	4010J	2490	NR
Lead		12.05	5.6	6.9	NR
Magnesium		794.5	178 J	536J	NR
Manganese		108	31J	59J	NR
Selenium		0.33	-	-	NR
Thallium		0.25	-	0.40J	NR
Vanadium		15.2	6.4J	3.7	NR
Zinc		16	30J	17J	NR

NOTES:

- = not detected
bgs = below ground surface
4,4'-DDT = 4,4'- dichlorodiphenyltrichloroethane
J = estimated concentration
mg/kg = milligrams per kilogram
NR = not requested
PCBs = polychlorinated biphenyls
µg/kg = micrograms per kilogram

Depth indicates top of sample interval.

Shaded results are below MMR background concentrations.

4.2 SUBSURFACE SOIL

Review of CLP analytical data indicates that 25 subsurface-soil samples collected from 5 to 65 feet bgs were analyzed for TCL VOCs; none were detected (Table 4-2a). Of the 18 samples analyzed for TCL SVOCs, one phthalate was detected in one sample only, at a concentration of 340 μg/kg. This concentration is barely above the CRQL of 330 μg/kg; as discussed previously, phthalates would not be expected at this site and are typical sampling and laboratory artifacts. Therefore, the one phthalate detection is not considered to represent site-related contamination.

Eighteen samples were analyzed for TCL pesticides and PCBs. The pesticide 4,4'-dichlorodiphenyltrichloroethane (DDT) was detected in three samples only, at concentrations of 18, 24, and 45 μg/kg, compared to the CRQL of 16 μg/kg. Pesticide detections were in deep soil, occurring at depths from 19 to 61 feet bgs; they likely reflect residual concentrations from widespread pesticide applications for insect control on MMR in the 1960s and 1970s. At these depths, pesticides affect no human or ecological receptors; therefore, the low 4,4'-DDT concentrations are not considered to represent contamination of concern.

The TAL inorganics beryllium, chromium, and copper each were detected once at concentrations above the MMR maximum background concentrations for subsurface soil. These three detections occurred in three different samples; in two of these, a duplicate sample failed to replicate the background exceedance. Additionally, the chromium and copper detections were at concentrations lower than the MMR maximum background concentration for surface soil. For this reason, and because the detections were not reproducible in duplicate samples, site-related contamination of subsurface soil by inorganic analytes is not indicated.

Interpretation of field laboratory analytical results for VOCs, SVOCs, pesticides, PCBs, and inorganics in subsurface-soil samples from the TerraProbe borings in the cesspool area support the conclusions derived from the CLP data that contaminants are not widespread around the former cesspool (Table 4-2b). The one sample that showed the presence of fuel-related compounds was a duplicate sample (i.e., the 8-foot bgs sample from 04TRX12) and no fuel-related compounds were detected in the original sample. At this same sample location, the duplicate sample contained detectable concentrations of copper and zinc while neither of these analytes was detected in the original sample.

TABLE 4-2a
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL - OFF-SITE ANALYSIS

STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

*Exploration ID: *Sampled: ANALYTES *Depth:	Maximum Background Conc. (mg/kg)	FS-21/TB-1 03-SEPT-87 13	FS-21/TB-1 03-SEPT-87 18	FS-21/TB-1 03-SEPT-87 28	FS-21/TB-1 03-SEPT-87 33	FS-21/TB-1 03-SEPT-87 63	FS-21/TB-1* 03-SEPT-87 63	FS-21/TB-2 10-SEPT-87 10	FS-21/TB-2 10-SEPT-87 39	FS-21/TB-2 10-SEPT-87 59	CS-8/TP-8 02-SEPT-87 5	CS-8/TB-1 01-SEPT-87 23	CS-8/TB-1 01-SEPT-87 43	CS-8/TB-1* 01-SEPT-87 43	CS-8/TB-1 01-SEPT-87 58	CS-8/TB-2 01-SEPT-87 19
VOLATILE ORGANIC COMPOUNDS (ug/kg	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS																
Butylbenzylphthalate	NA	NR	NR	-	NR	-	-	-	NR	-	340	-	-	-	-	-
PESTICIDES/PCBs (ug/kg)																
4,4'-DDT	NA	NR	NR	-	NR	-	-	-	NR	45	-	-	-	-	-	18
Aroclor 1260	NA	NR	NR	-	NR	-	-	-	NR	-	-	-	-	-	-	-
INORGANIC COMPOUNDS (mg/kg)																
Aluminum	1,980	NR	NR	677	NR	352	316	914	NR	432	647	259	401	925	483	420
Arsenic	2.3	NR	NR	0.66J	NR	-	0.65	-	NR	-	-	-	-	-	-	-
Barium	14.7	NR	NR	3.2J	NR	1.2J	-	4.0J	NR	3.4J	1.7J	1.5J	2.6J	4.1J	2.8J	1.5J
Beryllium	0.69	NR	NR	-	NR	-	1.3	-	NR	-	-	-	-	0.40J	-	-
Calcium	933	NR	NR	85J	NR	68J	75J	76J	NR	136J	27J	27J	36J	56J	42J	27J
Chromium	3.9	NR	NR	-	NR	-	-	4.3	NR	-	-	-	-	3.1	-	-
Cobalt	2.6	NR	NR	-	NR	-	-	-	NR	-	-	-	-	1.30J	1.5J	-
Copper	4.3	NR	NR	-	NR	-	-	0.94J	NR	-	4.1J	3.1J	3.2J	3.9J	4.7J	3.6J
Iron	2,600	NR	NR	1300	NR	825	573	2020J	NR	865J	961	418	718	2170	979	690
Lead	3.70	NR	NR	1.1	NR	0.72J	0.79J	1.8	NR	1.1J	1.0J	0.84J	0.82J	1.2	0.72J	0.78J
Magnesium	742.0	NR	NR	251J	NR	-	-	354J	NR	95J	129J	-	95J	557J	196J	-
Manganese	587	NR	NR	41J	NR	8.3J	5.20J	53J	NR	56J	19J	10J	15J	23J	53J	22J
Selenium	0.62	NR	NR	0.35J	NR	0.49J	-	-	NR	0.39J	-	-	-	-	-	-
Thallium	1.00	NR	NR	-	NR	-	-	-	NR	-	0.41J	0.45J	0.45J	0.44J	0.55J	0.41J
Vanadium	5.7	NR	NR	1.9J	NR	-	-	2.0J	NR	2.0J	-	-	-	2.9J	-	-
Zinc	16	NR	NR	6.0	NR	6.6	4.1J	8.7J	NR	8.7J	6.6J	6.7J	8.1J	9.2J	12J	7.6J

NOTES:
= not detected
= duplicate sample
4,4'-DDT = 4,4'-dichlorodiphenyltrichloroethane
= estimated concentration
= milligrams per kilogram
= not analyzed
= not requested
= polychlorinated biphenyls
= micrograms per kilogram
Depth indicates top of sample interval.
Shaded results are below MMR background concentrations.

TABLE 4-2a
SUMMARY OF ANALYTES DETECTED IN SUBSURFACE SOIL - OFF-SITE ANALYSIS

STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

"Exploration ID: "Sampled: ANALYTES "Depth:	Maximum Background Conc. (mg/kg)	CS-8/TB-2 01-SEPT-87 54	CS-8/TB-2* 01-SEPT-87 54	CS-8/TB-3 01-SEPT-87 8	CS-8/TB-3 01-SEPT-87 18	CS-8/TB-3 01-SEPT-87 58	CS-8/TB4 04-SEP-87 5	CS-8/TB4 04-SEP-87 8	CS-8/TB4 04-SEP-87 10	CS-8/TB4 04-SEP-87 34	CS-8/TB4 04-SEP-87 54
VOLATILE ORGANIC COMPOUNDS (ug/kg	NA	-	-	-	-	-	-	-	-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS											
Butylbenzylphthalate	NA	-	-	NR	-	-	NR	NR	-	-	-
PESTICIDES/PCBs (ug/kg)											
4,4'-DDT	NA	-	24	NR	-	-	NR	NR	-	-	-
Aroclor 1260	NA	-	-	NR	-	-	NR	NR	-	-	-
INORGANIC COMPOUNDS (mg/kg)											
Aluminum	1,980	409	469	NR	429	225	NR	NR	551	373	612
Arsenic	2.3	-	-	NR	-	-	NR	NR	0.55J	0.55J	0.63J
Barium	14.7	1.4J	1.3J	NR	1.7J	1.4J	NR	NR	2.1J	2.1J	3.8J
Beryllium	0.69	-	-	NR	-	-	NR	NR	-	-	-
Calcium	933	26J	29J	NR	23J	23J	NR	NR	81J	63J	93J
Chromium	3.9	-	-	NR	-	-	NR	NR	-	-	-
Cobalt	2.6	-	-	NR	-	-	NR	NR	-	-	-
Copper	4.3	4.3J	4.3J	NR	3.5J	3.6J	NR	NR	-	-	-
Iron	2,600	822	1060	NR	821J	416	NR	NR	893J	583	-
Lead	3.70	0.9J	0.81J	NR	2.1J	0.92J	NR	NR	0.98J	0.52J	0.87J
Magnesium	742.0	103J	147J	NR	83J	-	NR	NR	171J	82J	148J
Manganese	587	9.5J	24J	NR	27J	5.4J	NR	NR	46J	16J	14J
Selenium	0.62	-	-	NR	-	-	NR	NR	-	0.33J	-
Thallium	1.00	0.47J	0.52J	NR	0.52J	0.54J	NR	NR	-	-	-
Vanadium	5.7	-	-	NR	-	-	NR	NR	1.6J	-	-
Zinc	16	7.1J	8.8J	NR	7.1J	5.3	NR	NR	5.0	5.0	6.3

NOTES:
- = not detected
- = duplicate sample

4,4'-DDT = 4,4'-dichlorodiphenyltrichloroethane
- = estimated concentration
- = milligrams per kilogram
- = not analyzed
- = not requested
- = polychlorinated biphenyls
- = micrograms per kilogram

Depth indicates top of sample interval.
Shaded results are below MMR background concentrations

TABLE 4-2b
SUMMARY OF ANALYTES DETECTED IN SOIL - ON-SITE ANALYSIS

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPLORATION ID: / SAMPLED: / DEPTH:	Maximum Background Conc. (mg/kg)	04TRX11 28-FEB-92 4	04TRX11 28-FEB-92 8	04TRX11 28-FEB-92 12	04TRX11 28-FEB-92 18	04TRX11 28-FEB-92 24	04TRX12 28-FEB-92 4	04TRX12 28-FEB-92 8	04TRX12 28-FEB-92 8	04TRX12 28-FEB-92 12	04TRX12 28-FEB-92 18	04TRX12 28-FEB-92 24
ANALYTES												
VOCs (ug/kg)												
Toluene	NA	-	-	-	-	-	-	130	-	-	-	-
Ethylbenzene	NA	-	-	-	-	-	-	190	-	-	-	-
o-Xylene	NA	-	-	-	-	-	-	67	-	-	-	-
m/p-Xylene	NA	-	-	-	-	-	-	250	-	-	-	-
Pesticides/PCBs (µg/kg)												
Delta-BHC	NA	-	-	-	-	-	-	330	530	150	-	-
Heptachlor epoxide	NA	-	-	-	-	-	140	1700	1800	1300	-	-
Inorganics (mg/kg)												
Lead	3.7	-	-	-	-	-	-	-	-	-	-	-
Copper	4.3	-	-	-	-	-	-	270	-	-	-	-
Zinc	16.0	-	-	-	-	-	-	380	-	-	-	-
Arsenic	2.3	-	-	-	-	-	-	-	-	-	-	-
Chromium	3.9	-	-	-	-	-	-	-	-	-	-	-
TPH (mg/kg)	NA	130	83	84	120	120	130	980	820	83	120	40

NOTES:
- = not detected
N/A = not analyzed
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

TABLE 4-2b
SUMMARY OF ANALYTES DETECTED IN SOIL - ON-SITE ANALYSIS

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPLORATION ID: / SAMPLED: / DEPTH:	Maximum Background Conc. (mg/kg)	04TRX13 04-MAR-92 4	04TRX13 04-MAR-92 8	04TRX13 04-MAR-92 8	98TRX13 04-MAR-92 12	98TRX13 04-MAR-92 18	98TRX13 04-MAR-92 24	98TRX14 04-MAR-92 4	98TRX14 04-MAR-92 8	98TRX14 04-MAR-92 12	98TRX14 04-MAR-92 18	98TRX14 04-MAR-92 24
ANALYTES												
VOCs (ug/kg)												
Toluene	NA	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	NA	-	-	-	-	-	-	-	-	-	-	-
o-Xylene	NA	-	-	-	-	-	-	-	-	-	-	-
m/p-Xylene	NA	-	-	-	-	-	-	6.1	-	-	-	-
Pesticides/PCBs (µg/kg)												
Delta-BHC	NA	-	-	-	-	-	-	-	-	-	-	-
Heptachlor epoxide	NA	-	-	-	-	-	-	-	-	-	-	-
Inorganics (mg/kg)												
Lead	3.7	-	-	-	-	-	-	-	-	-	-	-
Copper	4.3	-	-	-	-	-	-	-	-	-	-	-
Zinc	16.0	-	-	-	-	-	-	-	-	-	-	-
Arsenic	2.3	-	-	-	-	-	-	-	-	-	-	-
Chromium	3.9	-	-	-	-	-	-	-	-	-	-	-
TPH (mg/kg)	NA	170	330	320	290	410	410	180	160	120	210	410

NOTES:
- = not detected
N/A = not analyzed
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

4.3 GROUNDWATER

A total of twelve groundwater samples (including four duplicates) were collected from four monitoring wells and one borehole located at Study Area CS-8/FS-21; however, not all samples were analyzed for all parameters. The analytical sampling program is presented in Table 3-1.

Organic Analytes: Site-related TCL VOCs were detected above laboratory detection limits in the groundwater sample collected from borehole 04BH0001; ethylbenzene and xylenes were detected at concentrations of 1.14 and 3.04 µg/l, respectively. Although 2-butanone was detected in groundwater samples collected from monitoring well CS8/MW2, the lack of 2-butanone detected in groundwater from adjacent wells and from groundwater collected from CS8/MW2 in 1999, indicates that its presence in 1989 was likely due to sample contamination introduced during collection and/or laboratory analysis (Haase, et al., 1988 and E.C. Jordan Co., 1991). As a result of these findings, 2-butanone was not considered a site-related contaminant of potential concern and was not evaluated in the PRE/PRA.

Site-related TCL SVOCs were detected above laboratory detection limits in the groundwater sample collected from borehole 04BH0001; Acenapthene and Fluorene were detected at concentrations of 0.16 and 0.18 µg/l, respectively. Naphthalene was detected at an estimated concentration of 0.08 µg/l (below its quantitation limit) from this same sample.

Borehole 04BH0001 had been advanced in 1999 primarily to confirm benzo(b/k)fluoranthene and bis(2-ethylhexyl)phthalate concentrations detected below CRQLs in a 1988 groundwater sample collected from monitoring well FS-21/MW-2, which had since been destroyed. These contaminants were not detected in the 1999 borehole sample that was advanced in the approximate same location as FS-21/MW-2. The presence of benzo(b/k)fluoranthene in the historical groundwater sample collected from well FS-21/MW-2 may be due to soil derived suspended solids (i.e., turbidity) that were introduced into the groundwater during sampling using non-low-flow techniques. The groundwater Field Sample Data Record for this 1988 sample stated that the groundwater sample appearance was "light brown with moderate suspended solids" (E.C. Jordan, 1990a). As a result of this data, benzo(b/k)fluoranthene was not considered a site-related contaminant of potential concern and was not evaluated in the PRE/PRA.

Inorganic Analytes: In a comprehensive study of inorganic concentrations in groundwater at the MMR conducted in 1996-1997, where 158 groundwater monitoring wells were sampled and analyzed for inorganic analytes (*MMR Inorganics Investigation Technical Memorandum, Jacobs Engineering, 1998*), it was determined that samples collected using the USEPA Region I Low Flow (Minimum Stress) Purging and Sampling Procedure

(USEPA, 1996a) consistently have lower concentrations of suspended solids, and therefore, lower total metals concentrations than samples collected using more traditional (high flow) sampling techniques (Jacobs, 1998). The study also found that metals data representing MMR "background" conditions were probably biased on the high side by the method used to collect the groundwater samples, and that these data are suspect.

Because groundwater samples collected prior to 1999 at the site did not use the Low Flow (Minimum Stress) Purging and Sampling Procedure, this pre-1999 laboratory data was not considered reliable. Only data obtained during the March and December 1999 sampling rounds, which used the Low Flow (Minimum Stress) Purging and Sampling Procedure was used to evaluate the site. The March 1999 sampling round sampled wells CS-8/MW-2 and FS-21/MW-1. Manganese (708 μg/l) and Beryllium (0.94J μg/l) were detected at concentrations above groundwater screening criteria, although the Beryllium detected was below sample quantitation limits. The December 1999 sampling round collected groundwater from borehole 04BH001 and detected arsenic (7.4J μg/l) above groundwater screening criteria, although it was also below sample quantitation limits.

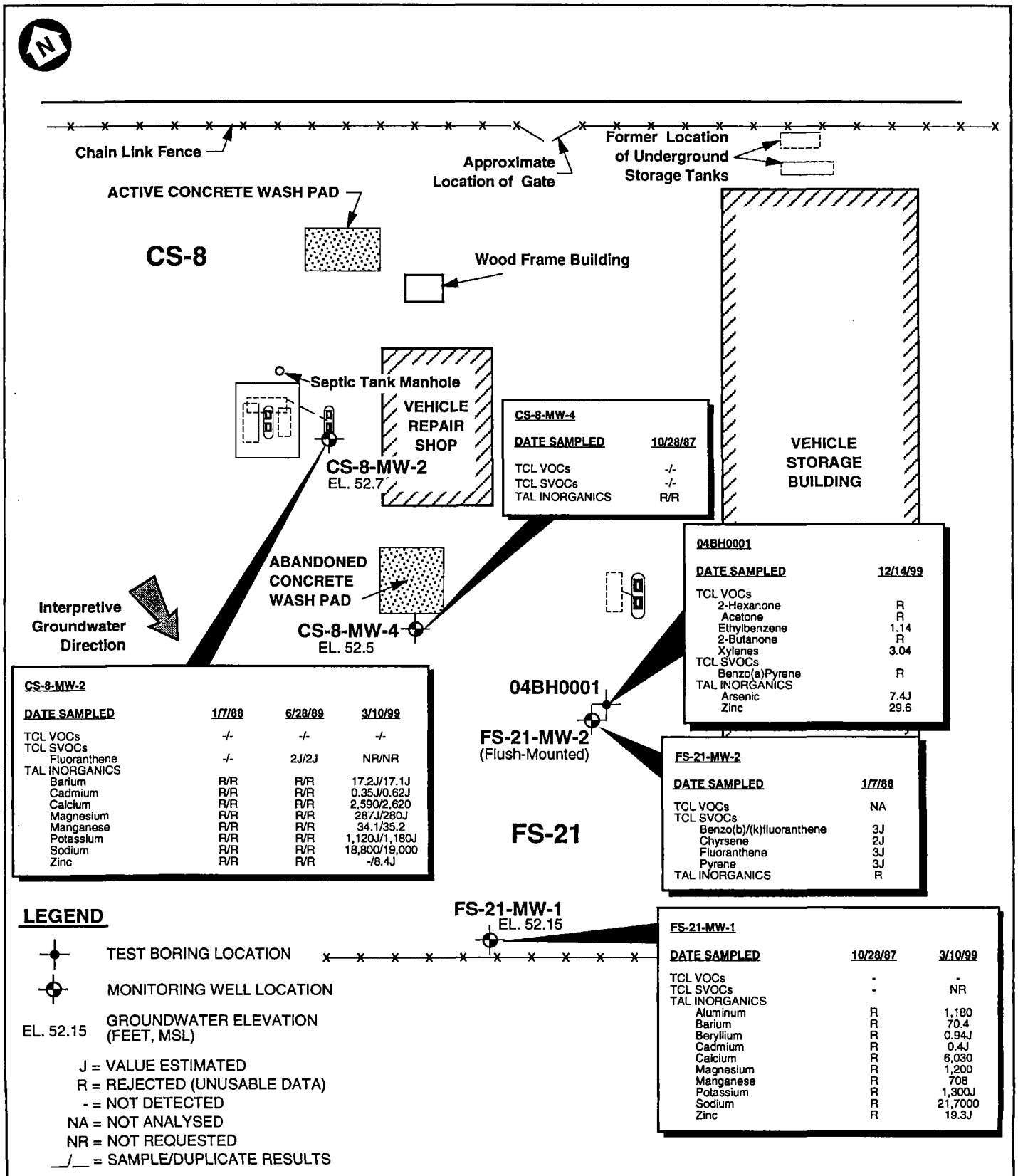
TABLE 4-3
SUMMARY OF ANALYTES DETECTED IN GROUNDWATER - OFF-SITE ANALYSIS

STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

"Exploration ID:	CS-8/MW-2	CS-8/MW-2*	CS-8/MW-2	CS-8/MW-2*	CS-8/MW-2	CS-8/MW-2*	CS-8/MW-4	CS-8/MW-4*	FS-21/MW-1	FS-21/MW-1	FS-21/MW-2	04BH0001
"Sampled:	07-JAN-88	07-JAN-88	28-JUNE-89	28-JUNE-89	10-Mar-99	10-Mar-99	28-OCT-87	28-OCT-87	28-OCT-87	10-Mar-99	07-JAN-88	14-Dec-99
VOLATILE ORGANIC COMPOUNDS (ug/L)												
2-Butanone	-	-	6400	3800	-	-	-	-	-	-	NR	R
2-Hexanone	-	-	-	-	-	-	-	-	-	-	NR	R
Acetone	-	-	-	-	-	-	-	-	-	-	NR	R
Ethylbenzene	-	-	-	-	-	-	-	-	-	-	NR	1.14
Xylenes	-	-	-	-	-	-	-	-	-	-	NR	3.04
SEMIVOLATILE ORGANIC COMPOUNDS (ug/L)												
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	R
Benzo(b)/(k)fluoranthene	-	-	-	-	NR	NR	-	-	-	NR	3J	-
Chyrsene	-	-	-	-	NR	NR	-	-	-	NR	2J	-
Naphthalene	-	-	2J	2J	NR	NR	-	-	-	NR	-	-
Fluoranthene	-	-	-	-	NR	NR	-	-	-	NR	3J	-
Pyrene	-	-	-	-	NR	NR	-	-	-	NR	3J	-
Bis (2-ethylhexyl)phthalate	2J	4J	-	-	NR	NR	-	-	-	NR	13J	-
INORGANIC COMPOUNDS (ug/L)												
Aluminum	R	R	R	R	-	-	R	R	R	1180	R	-
Arsenic	R	R	R	R	-	-	R	R	R	-	R	7.4J
Barium	R	R	R	R	17.2 J	17.1 J	R	R	R	70.4	R	-
Beryllium	R	R	R	R	-	-	R	R	R	0.94 J	R	-
Cadmium	R	R	R	R	0.35 J	0.62 J	R	R	R	0.4 J	R	-
Calcium	R	R	R	R	2590	2620	R	R	R	6030	R	-
Magnesium	R	R	R	R	287 J	280 J	R	R	R	1200	R	-
Manganese	R	R	R	R	34.1	35.2	R	R	R	708	R	-
Potassium	R	R	R	R	1120 J	1180 J	R	R	R	1300 J	R	-
Sodium	R	R	R	R	18800	19000	R	R	R	21700	R	-
Zinc	R	R	R	R	-	8.4 J	R	R	R	19.3 J	R	29.6
TOTAL PETROLEUM HYDROCARBONS (mg/L)	NR	NR	-	-	NR	NR	NR	NR	NR	NR	NR	NR

NOTES:

- = not detected
* = duplicate sample
J = estimated concentration
mg/L = milligrams per liter
MW = monitoring well
NR = not requested
R = rejected (unusable results)
µg/L = micrograms per liter



CS-8-MW-4

DATE SAMPLED	10/28/87
TCL VOCs	-/-
TCL SVOCs	-/-
TAL INORGANICS	R/R

04BH0001

DATE SAMPLED	12/14/99
TCL VOCs	
2-Hexanone	R
Acetone	R
Ethylbenzene	1.14
2-Butanone	R
Xylenes	3.04
TCL SVOCs	
Benzo(a)Pyrene	R
TAL INORGANICS	
Arsenic	7.4J
Zinc	29.6

CS-8-MW-2

DATE SAMPLED	1/7/88	6/28/89	3/10/99
TCL VOCs	-/-	-/-	-/-
TCL SVOCs			
Fluoranthene	-/-	2J/2J	NR/NR
TAL INORGANICS			
Barium	R/R	R/R	17.2J/17.1J
Cadmium	R/R	R/R	0.35J/0.62J
Calcium	R/R	R/R	2,590/2,620
Magnesium	R/R	R/R	287J/280J
Manganese	R/R	R/R	34.1/35.2
Potassium	R/R	R/R	1,120J/1,180J
Sodium	R/R	R/R	18,800/19,000
Zinc	R/R	R/R	-/8.4J

FS-21-MW-2

DATE SAMPLED	1/7/88
TCL VOCs	NA
TCL SVOCs	
Benzo(b)(k)fluoranthene	3J
Chyrsene	2J
Fluoranthene	3J
Pyrene	3J
TAL INORGANICS	R

FS-21-MW-1

DATE SAMPLED	10/28/87	3/10/99
TCL VOCs	-	-
TCL SVOCs	-	NR
TAL INORGANICS		
Aluminum	R	1,180
Barium	R	70.4
Beryllium	R	0.94J
Cadmium	R	0.4J
Calcium	R	6,030
Magnesium	R	1,200
Manganese	R	708
Potassium	R	1,300J
Sodium	R	21,7000
Zinc	R	19.3J

LEGEND

- TEST BORING LOCATION
- MONITORING WELL LOCATION
- EL. 52.15 — GROUNDWATER ELEVATION (FEET, MSL)

J = VALUE ESTIMATED
R = REJECTED (UNUSABLE DATA)
- = NOT DETECTED
NA = NOT ANALYSED
NR = NOT REQUESTED
__/__ = SAMPLE/DUPLICATE RESULTS

NOTES

1. ORGANIC AND INORGANIC RESULTS IN µg/L.
2. GROUNDWATER DIRECTION FROM MARCH 1988 DATA (E.C. JORDAN CO., 1988).

SCALE IN FEET
0 50 100

Harding Lawson Associates
Engineering and Environmental Services

STUDY AREAS CS-8/FS-21
INTERPRETIVE GROUNDWATER
ANALYTICAL RESULTS

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

DECISION DOCUMENT

FIGURE 4-1

9905003D(b) ABCD

5.0 PRELIMINARY RISK EVALUATION

This section describes how the human-health and ecological PREs were conducted and presents the results of each.

5.1 INTRODUCTION

A PRE was conducted at Study Areas CS-8/FS-21 to provide a screening-level assessment of potential risks to human and ecological receptors associated with exposure to environmental contaminants identified during site characterization efforts.

5.1.1 Approach

A PRE is a worst-case analysis that addresses the most sensitive receptors and all potential current and future pathways. The human health PRE was performed using current USEPA Region I risk assessment guidance (USEPA, 1989b; 1994; 1995; 1996; 1999a, 2000c). The ecological PRE followed the approach outlined in the MMR Risk Assessment Handbook (RAH) (Automated Sciences Group, Inc. [ASG], 1994).

Data were evaluated for surface soil, subsurface soil, and groundwater collected at Study Areas CS-8/FS-21 during the SI and subsequent sampling events. The data were determined to be sufficient to complete human-health and ecological PREs at these study areas. The ecological PRE considered exposures to surface soil only; the human-health PRE included an evaluation of exposures to surface soil, subsurface soil, and groundwater. No surface water or sediment exists at this site.

The human health PRE was performed as a two-step process. First, analytes that could pose a health risk of concern were identified by comparing the maximum detected concentrations to conservative, health-based screening values. Analytes with maximum detected concentrations that were less than the screening values were considered to not pose a health risk of concern (i.e., they posed a *de minimus* risk) and therefore, were not further evaluated. Analytes with maximum detected concentrations that exceeded the screening values were retained for further evaluation as chemicals of potential concern (CPCs). In the second step, analytes selected as CPCs were evaluated to assess whether potential exposure to the CPCs would be associated with acceptable cumulative cancer and noncancer risks. This evaluation was performed by identifying an exposure point

concentration (EPC) for each CPC, and then quantitatively evaluating exposure doses and risks using default residential exposure and toxicity assumptions recommended by USEPA. The cumulative risks were compared to USEPA and MADEP cumulative receptor risk limits to determine if the health risks meet risk management criteria.

The ecological PRE also followed a tiered approach. In the Tier I analysis, maximum reported analyte concentrations were compared to Hazard Equivalent Concentration (HECs) based on the most sensitive receptor species likely to inhabit the study areas. If maximum site concentrations exceed HECs for Tier I, a remedial investigation (RI) can be recommended without Tier II evaluation. Otherwise, a Tier II evaluation is completed to compare maximum concentrations to HECs for indicator species likely to inhabit the study areas based on future land-use plans.

5.1.2 Study Areas CS-8/FS-21 Objectives

The purposes of this PRE were as follows:

- select CPCs
- identify human and ecological exposure pathways
- identify human and ecological receptors
- evaluate possible human health risks by calculating quantitative risk estimates for potential exposures to CPCs and by comparing CPCs at Study Areas CS-8/FS-21 to applicable or relevant and appropriate requirements
- evaluate possible ecological risks by comparing CPCs at Study Areas CS-8/FS-21 to HECs

The PRE was conducted to support the recommendation of one of the following alternatives: (1) decision document (no further action), (2) RI/feasibility study, or (3) removal action.

5.2 HUMAN-HEALTH PRELIMINARY RISK EVALUATION

The purpose of the PRE for Study Areas CS-8/FS-21 was to identify potential human-health risks associated with exposures to study-area-related CPCs.

5.2.1 Data Evaluation

Analytical data available for Study Areas CS-8/FS-21 were evaluated to identify study-area- and medium-specific CPCs. Frequencies of detection, ranges of CRQLs and CRDLs, and a range of minimum to maximum detected concentrations of analytes detected in surface soil, subsurface soil, and groundwater are listed in Tables 5-1, 5-2, and 5-3, respectively.

Surface soil data consisting of soil samples collected 0-2 ft bgs are identified in Table 4-1 and are summarized in Table 5-1. Surface soil data were collected in accordance with the SI workplan for CS-8/FS-21.

In accordance with USEPA Region I guidance (USEPA, 1995), subsurface soils considered for evaluation in health risk assessment should be represented by the depth intervals that could realistically be contacted by individuals under the current and foreseeable future land uses. USEPA Region I has defined this depth as up to 10 ft bgs. Subsurface soil data for soil samples collected 2-10 ft bgs identified in Table 4-2a were used to develop the data summary presented in Table 5-2.

As discussed in Section 4.3, 2-butanone was detected in groundwater samples collected in 1989 from monitoring well CS8/MW2. The lack of 2-butanone detected in groundwater from adjacent wells and from groundwater collected from CS8/MW2 in 1999 indicates that its presence in 1989 was likely due to sample contamination introduced during collection and/or laboratory analysis (Haase, et al., 1988 and E.C. Jordan Co., 1991). As a result of these findings, 2-butanone was not considered a site-related contaminant of potential concern and was not evaluated in the PRE/PRA.

Soil samples collected from the TerraProbe borings installed around the cesspool in 1992 were analyzed in an on-site laboratory to characterize the extent of soil contamination in support of a removal action. Samples were not submitted for off-site analysis. Therefore, the field screening soil data collected from the TerraProbe boring locations were qualitatively evaluated by a comparison of detected concentrations to USEPA Region IX residential soil preliminary remediation goals (PRGs). Detected concentrations of all VOCs, copper, and zinc are substantially lower than their respective residential soil PRGs. The greatest TPH concentrations (820 mg/kg and 980 mg/kg in the 8-foot bgs sample from 04TRX12) are slightly greater than the MADEP S-1 Method 1 standard for TPH (800 mg/kg) provided in the Massachusetts Contingency Plan, 310 CMR 40.0985(6)

(MADEP, 1999). The concentrations of delta-BHC and heptachlor epoxide exceed the USEPA Region IX residential soil PRGS. In 1996, the cesspool and approximately 40 cubic yards of contaminated soil were removed during the DSRP. The four TerraProbe boring locations were located in the area of the removal action. Confirmation soil samples collected during the removal action from the sidewalls and bottom of the excavation were submitted for off-site laboratory analysis. The results were all below the cleanup levels established for the removal action, as well as the USEPA Region IX residential soil PRGs.

The groundwater data set (see Table 5-3) consists of 8 groundwater samples collected from four monitoring wells. There are three rounds of data from CS-8/MW-2, one round of data from CS-8/MW-4, two rounds of data from FS-21/MW-1, one round of data from FS-21/MW-2, and one round of data from 04BH001 (a borehole advanced at the former location of FS-21/MW-2, which had been destroyed). Groundwater data from monitoring wells sampled during and after 1995 were obtained using low-flow sampling techniques. Therefore, only inorganics data from the groundwater sampling rounds at CS-8/MW-2 (March 1999), FS-21/MW-1 (March 1999), and 04BH001 (December 1999) were used in the PRE; inorganics data for non-low-flow sampling performed prior to 1995 were not evaluated in the PRE. Groundwater data for semivolatile organics obtained from the January 1988 sampling round at FS-21/MW-2 were not used in the PRE because the presence of these analytes was determined to be an artifact of suspended solids in the sample. The December 1999 sample round at this well location was analyzed for SVOCs, and none were detected. Therefore, the data for the December 1999 sampling round at 04BH001 were used in the PRE.

TABLE 5-1
CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL	FREQUENCY OF DETECTION	CRQL/ CRDL (mg/kg)	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	MAXIMUM BACKGROUND CONC. (mg/kg)	REGION IX RESIDENTIAL PRG (mg/kg)	SELECTED AS A CPC?	NOTES
SEMIVOLATILE ORGANIC COMPOUNDS							
Bis(2-ethylhexyl)phthalate	1/2	0.33	0.064 - 0.064	NA	35	NO	2
Butylbenzylphthalate	1/2	0.33	0.14 - 0.14	NA	1,200	NO	2
PCBs/PESTICIDES							
Aroclor-1260	1/2	0.16	0.66 - 0.66	NA	0.22	YES	1
INORGANICS							
Aluminum	2/2	40	1,300 - 3,220	8,930	7,600	NO	2
Arsenic	2/2	2	0.69 - 2.2	3.6	0.39	YES	1
Barium	2/2	40	9.6 - 11	10.4	540	NO	2
Beryllium	1/2	1	0.37 - 0.37	0.65	15	NO	2
Calcium	2/2	1,000	218 - 331	969	NA	NO	3
Chromium	2/2	2	2.1 - 5.3	6.8	30	NO	2
Cobalt	1/2	10	1.5 - 1.5	4.1	470	NO	2
Copper	1/2	5	9.2 - 9.2	5.2	290	NO	2
Iron	2/2	20	2,490 - 4,010	12,400	2,300	NO	3
Lead	2/2	3	5.6 - 6.9	12.05	400	NO	2
Magnesium	2/2	1,000	178 - 536	794.5	NA	NO	3
Manganese	2/2	3	31 - 59	108	180	NO	2
Thallium	1/2	2	0.4 - 0.4	0.25	0.63	NO	2
Vanadium	2/2	10	3.7 - 6.4	15.2	55	NO	2
Zinc	2/2	4	17 - 30	16	2,300	NO	2

NOTES:
NA = not applicable
CPC = contaminant of potential concern
CRQL = Contract Required Quantitation Limit
CRDL = Contract Required Detection Limit
mg/kg = milligrams per kilogram
PRG - Preliminary Remediation Goal. Values are obtained from the Region IX PRG Table (USEPA, 1999). PRGs presented in this table are based on the lesser of a cancer risk of 1E-06 or a non-cancer hazard index of 0.1.

1 Chemical selected as a CPC because the maximum detected concentration exceeds the Region IX PRG.
2 Chemical not retained as a CPC because the maximum detected concentration is less than the Region IX PRG.
3 Chemical not retained as a CPC because it is an essential nutrient.

TABLE 5-2
CONTAMINANTS OF POTENTIAL CONCERN IN SUBSURFACE SOIL (2-10' bgs)

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL	FREQUENCY OF DETECTION	CRQL/ CRDL (mg/kg)	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	MAX. BKGRD CONC. (mg/kg)	REGION IX RESIDENTIAL PRG (mg/kg)	SELECTED AS A CPC?	NOTES
SEMIVOLATILE ORGANIC COMPOUNDS							
Butylbenzylphthalate	1/2	0.34	0.34	NA	1200	NO	2
INORGANICS							
Aluminum	3/3	-	551 - 914	1,980	7,600	NO	2
Arsenic	1/3	2	0.55 J	2.3	0.39	YES	1
Barium	3/3	-	1.7J - 4.0J	14.7	540	NO	2
Calcium	3/3	-	27J - 81J	933	NA	NO	3
Chromium	1/3	2	4.3	3.9	30	NO	2
Copper	2/3	5	0.94J - 4.1J	4.3	290	NO	2
Iron	3/3	-	893J - 2020J	2,600	2,300	NO	3
Lead	3/3	-	0.98J - 1.8	3.7	400	NO	2
Magnesium	3/3	-	129J - 354J	742	NA	NO	3
Manganese	3/3	-	19J - 53J	587	180	NO	2
Thallium	1/2	2	0.41J	1	0.63	NO	2
Vanadium	2/3	10	1.6J - 2.0J	5.7	55	NO	2
Zinc	3/3	-	5.0 - 8.7J	16	2,300	NO	2

NOTES:
NA = not applicable
CPC = contaminant of potential concern
CRQL = Contract Required Quantitation Limit
CRDL = Contract Required Detection Limit
mg/kg = milligrams per kilogram
PRG - Preliminary Remediation Goal. Values are obtained from the Region IX PRG Table (USEPA, 1999). PRGs presented in this table are based on the lesser of a cancer risk of 1E-06 or a non-cancer hazard index of 0.1.

1 Chemical selected as a CPC because the maximum detected concentration exceeds the Region IX PRG.
2 Chemical not retained as a CPC because the maximum detected concentration is less than the Region IX PRG.
3 Chemical not retained as a CPC because it is an essential nutrient.
'-' = Analyte was detected in all samples analyzed.

TABLE 5-3
CONTAMINANTS OF POTENTIAL CONCERN IN GROUNDWATER

STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL	FREQUENCY OF DETECTION	CRQL/CRDL (ug/L)	RANGE OF DETECTED CONCENTRATIONS (ug/L)	REGION IX TAPWATER PRG (ug/L)	USEPA MCL (ug/L)	MADEP MCL (ug/L)	SELECTED AS A CPC?	NOTES
Volatile Organic Compounds								
Ethylbenzene	1/7	1	1.14 - 1.14	130	700	700	NO	2
Xylene	1/7	1	3.04 - 3.04	140	10000	10000	NO	2
Semi-Volatile Organic Compounds								
Bis(2-ethylhexyl)phthalate	1/5	10	2 - 4 *	4.8	6	6	NO	2
Naphthalene	1/5	10	2 - 2	0.62	NA	NA	YES	1
Inorganic Compounds								
Arsenic	1/3	10	7.4 - 7.4	0.045	50	50	YES	1
Aluminum	1/2	80	1180 - 1180	3600	NA	NA	NO	2
Barium	2/2	-	17.2 - 70.4	260	2000	2000	NO	2
Beryllium	1/3	5	0.94 - 0.94	7.3	4	4	NO	2
Cadmium	2/3	5	0.4 - 0.48	1.8	5	5	NO	2
Calcium	2/2	-	2325 - 6030	NA	NA	NA	NO	3
Magnesium	2/2	-	283 - 1200	NA	NA	NA	NO	3
Manganese	2/2	-	34.7 - 708	88	NA	NA	YES	1
Potassium	2/2	-	1150 - 1300	NA	NA	NA	NO	3
Sodium	2/2	-	18,900 - 21,700	NA	NA	NA	NO	3
Zinc	3/3	20	8.4 - 29.3	1100	NA	NA	NO	2

NOTES:

NA = Not available
CPC = contaminant of potential concern
CRQL = contract required quantitation limit
CRDL = contract required detection limit
ug/L = micrograms per liter
* = range for original and duplicate results
PRG - Preliminary Remediation Goal. Values are obtained from the Region IX PRG Table (USEPA, 1999). PRGs presented in this table are based on the lesser of a cancer risk of 1E-06 or a non-cancer hazard index of 0.1.
MCL - Maximum Contaminant Level. USEPA primary drinking water standard (USEPA, 2000); Massachusetts primary drinking water standard (MADEP, 2000).
1 Chemical selected as a CPC because the maximum detected concentration exceeds the Region IX PRG or MCL.
2 Chemical not retained as a CPC because the maximum detected concentration is less than the Region IX PRG and MCL.
3 Chemical not retained as a CPC because it is an essential nutrient.
'-' = Analyte was detected in all samples analyzed.

5.2.2 Contaminants of Potential Concern

CPCs are analytes that are potentially related to contamination sources at the site and are present at concentrations that may pose a health risk of concern. CPCs were identified by comparing maximum detected site concentrations to health-based screening values. This methodology results in a conservative evaluation that does not overlook or dismiss analytes that could pose potentially substantial risks.

The procedure used to select CPCs is summarized as follows, and is consistent with USEPA Region I (1999) methodology:

- Selected as a CPC in **surface soils** if the maximum detected concentration exceeds the USEPA Region IX PRG for residential soils (USEPA, 1999b).
- Selected as a CPC in **subsurface soils** if the maximum detected concentration exceeds the USEPA Region IX PRG for residential soils (USEPA, 1999b).
- Selected as a CPC in **groundwater** if the maximum detected concentration exceeds the lesser of the USEPA Region IX PRG for tapwater (USEPA, 1999b), the USEPA MCLs (USEPA, 2000a) and Massachusetts MCLs (MADEP, 2000) for drinking water (the potentially applicable ARAR).
- Eliminated as a CPC if an essential nutrient. The following inorganic analytes are considered essential human nutrients: calcium, magnesium, iron, potassium, and sodium.

The PRGs are protective for direct contact (ingestion and dermal contact) exposures, as well as for inhalation of dusts and vapors. The PRGs are derived for a $1x10^{-6}$ cancer risk level or a non-cancer hazard quotient (HQ) of 1. Per USEPA Region I guidance (USEPA, 1995), the PRGs based on noncarcinogenic effects have been adjusted for a HQ of 0.1 for the purposes of CPC selection.

As shown in Table 5-1, aroclor-1260 and arsenic were selected as CPCs in surface soil. Arsenic was selected as a CPC in subsurface soil (see Table 5-2). In groundwater, naphthalene, arsenic, and manganese were selected as CPCs (see Table 5-3). The COPCs were further evaluated to assess whether they posed cumulative risks for unrestricted land use in excess of the USEPA and MADEP cumulative risk limits.

5.2.3 Cumulative Receptor Risks

Study Area CS-8/FS-21 is located outside the MMR Security Zone/Flightline Area. Therefore, it is assumed that future land use could include residential development. To provide a conservative assessment of potential future land uses and health risks associated with possible exposures to the CPCs in surface soil, subsurface soil, and groundwater, cumulative receptor risks are estimated for residential land use.

Cumulative receptor risks were calculated to assess whether the CPCs are present at concentrations that could pose a significant health risk for the future residential use of the site. This determination was made by comparing the calculated risks for a residential exposure scenario with the USEPA cumulative receptor risk limits of an excess lifetime cancer risk of $1x10^{-6}$ to $1x10^{-4}$ and a hazard index (HI) of 1 for noncancer risks, and the MADEP cumulative receptor risk limit of an excess lifetime cancer risk of $1x10^{-5}$ and a HI of 1 for noncancer risks.

Calculation of cumulative receptor risks involved four components:

1. Identification of CPC exposure point concentrations
2. Calculation of receptor CPC intakes
3. Quantification of CPC toxicity
4. Calculation of cancer and noncancer risks

5.2.3.1 Calculation of CPC Exposure Point Concentrations

In accordance with USEPA guidance, the EPCs for soil were based on the lesser of the 95% upper confidence limit (UCL) on the arithmetic mean concentration or the maximum detected concentration. Because the surface soil and subsurface soil data sets each have less than 10 samples, the 95% UCL statistic was not used (USEPA, 1992). Therefore, the maximum detected concentrations were used as the EPCs for soil. For groundwater, USEPA Region I requires that each monitoring well be treated as a separate exposure point. Therefore, the CPC concentrations reported in each monitoring well represent the EPCs. To streamline the risk calculation, the maximum detected concentration of each CPC from among all monitoring wells was used as the EPC. The health risks calculated using this approach are equal to or higher than the risks that would be associated with any single well.

5.2.3.2 Calculation of Receptor CPC Intakes

Intakes and risks for residential land use were quantified for child and adult resident scenarios in accordance with USEPA Region I risk characterization guidance (USEPA, 1994). It is assumed that adults and children who may live at the site in the future could be exposed to CPCs in surface soil through incidental ingestion, dermal contact, and inhalation of soil particulates with sorbed SVOCs or inorganic compounds. It is further assumed that subsurface soils may be relocated to the surface, thereby becoming accessible via these same exposure pathways. Groundwater is considered a potable water source. Therefore, exposures to groundwater via ingestion of the water as residential tapwater and dermal contact during showering are evaluated. Since VOCs were not selected as CPCs in groundwater, possible volatile inhalation exposures to groundwater are not evaluated (i.e., since VOCs were not selected as CPCs, they would not pose a risk of concern via this exposure pathway).

The exposure parameters used to quantify CPC intakes are provided in Table 5-4, and are based on USEPA Region I default exposure variables (USEPA, 1994). In summary, child and adult residents are assumed to contact soils 150 days per year, over a 30-year period.

To evaluate non-cancer effects to sensitive individuals, the 30-year exposure is evaluated separately for young children (exposures to children ages 1 through 6 over a six-year duration) and adults (exposures over a 24-year period). Use of groundwater as a potable source is evaluated for an adult resident receptor that is assumed to ingest 2 liters of water per day, 350 days per year, over a 30-year period.

Dermal exposures to soil were calculated using the recent USEPA RAGS Part E Supplemental Guidance for Dermal Risk Assessment (Interim) (USEPA, 2000c). As recommended in this guidance, the skin surface areas and soil adherence factors are 2,800 cm^2 and 0.2 mg/cm^2, respectively for children, and 5,700 cm^2 and 0.07 mg/cm^2, respectively, for adults. Dermal absorption factors for the CPCs in surface and subsurface soil (arsenic and arcolor-1260) are also published in this guidance (USEPA, 2000c). The dermal exposure assessment procedure described in the RAGS Part E interim guidance for the water pathway was also applied to the residential water use scenario. Based on these procedures, arsenic and manganese dermal exposures and risks are considered relatively insignificant (i.e., dermal dose < 10% ingestion dose) and are not quantified. Naphthalene dermal exposures and risks are quantified using the procedure described in the recent draft guidance.

TABLE 5-4
EXPOSURE PARAMETERS - RESIDENT

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

PARAMETER	ADULT RESIDENT	CHILD RESIDENT	UNITS	SOURCE [1]
Soil Ingestion Rate	100	200	mg/day	USEPA, 1994
Fraction Ingested From Site	100%	100%		Assumption
Drinking Water Ingestion Rate	2	NA	L/day	USEPA, 1994
Exposure Time - outdoor [2]	8	8	hours/day	Assumption
Exposure Time - bathing [7]	0.58	NA	hours/day	USEPA, 2000
Exposure Frequency - outdoor [2]	150	150	days/year	USEPA, 1994
Exposure Frequency - indoor [3]	350	350	days/year	USEPA, 1994
Exposure Duration	24	6	years	USEPA, 1994
Body Weight	70	15	kg	USEPA, 1994
Averaging Time				
Cancer	70	70	years	USEPA, 1989
Noncancer [5]	24	6	years	USEPA, 1989
Surface Area Exposed - Soil [4]	5700	2800	cm^2/day	USEPA, 2000
Surface Area Exposed - Groundwater [4]	18000	NA	cm^2/day	USEPA, 2000
Inhalation Rate [6]	0.63	0.35	m^3/hour	USEPA, 1997
Permeability Coefficient	chemical-specific	NA	cm/hour	USEPA, 2000
Dermal Absorption Factor	chemical-specific	chemical-specific	ABSd	USEPA, 2000
Soil Adherence Factor [4]	0.07	0.2	mg/cm^2	USEPA, 2000
Particulate Emission Factor	1.32E+09	1.32E+09	m^3/kg	USEPA, 1996

Notes:

1 - Exposure variables with source listed as "assumption" are site specific; the remainder are default values.
2 - Values used to calculate exposure to soil and soil-derived dust
3 - Values used to calculate exposure to indoor air (vapors)
4 - Values recommended for residential exposures
5 - The AT for noncarcinogenic effects is equal to the exposure duration
6 - Adult value is recommended chronic value for adults (15.2 m^3/24-hour period);
child value is recommended value for 3-5 year old children (8.3 m^3/24-hour period). Values converted to rate/hour by dividing by 24-hours.
7 - RME value for time spent in a shower.
mg - milligrams
cm^2 - square centimeters
m^3 - cubic meters
kg - kilograms
NA - Not Applicable; exposure not evaluated.
RME - Reasonable maximum exposure

USEPA, 1989. "Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)"; Office of Emergency and Remedial Response; EPA-540/1-89/002 (interim final); Washington, D.C., December.
USEPA, 1991. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance Standard Default Exposure Factors"; Office of Emergency and Remedial Response, Toxics Integration Branch; OSWER Directive 9285.6-03
USEPA, 1994. "Risk Updates No. 2"; USEPA Region I, Waste Management Division; August. Values from "Attachment 2" to Risk Updates No. 2.
USEPA, 1996. "Soil Screening Guidance: Technical Background Document' EPA/540/R-95/128. May.
USEPA, 1997. "Exposure Factors Handbook, Volume 1"; Office of Research and Development; EPA-600/P-95/002Fa; Washington, D.C.; August.
USEPA, 2000. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual Supplemental Guidance (Part E, Dermal Risk Assessment) Interim Guidance

Tables 5-5 through 5-9 document the intake calculations and risk calculations.

5.2.3.3 Quantification of CPC Toxicity

Risks were calculated by combining CPC intakes with dose-response data that quantify the toxicity associated with each CPC. Cancer slope factors developed by USEPA (USEPA, 1997; 2000b) were used for evaluating carcinogenic effects. Chronic reference doses developed by USEPA (USEPA, 1997 and 2000b) were used for evaluating non-cancer effects. For evaluating risks associated with dermal exposures to soil, dermal cancer slope factors and reference doses were calculated using the oral absorption factors and technical approach recommended in USEPA guidance (USEPA, 1999a and 2000c). In accordance with this guidance, manganese is the only CPC for which dermal dose-response values are calculated. The dose-response values are presented in Tables 5-5 through 5-9.

5.2.3.4 Calculation of Cancer and Noncancer Risks

Table 5-10 provides a summary of the risk estimates for the resident receptor scenarios. The cumulative cancer risks for soil (i.e., sum of risks for ingestion, dermal, and inhalation exposures) are $2.6x10^{-6}$ for a child resident and $1.2x10^{-6}$ for an adult resident. The aggregate resident receptor cancer risk for soil is $3.8x10^{-6}$. Non-cancer hazard index values are below 1 for soil (0.03 for the adult and 0.3 for the child). The cancer risk values for potential exposures to soil are within the USEPA cancer risk range of $1x10^{-6}$ to $1x10^{-4}$ and are below the MADEP cumulative cancer risk limit of $1x10^{-5}$. The HI values for potential exposures to soil do not exceed the USEPA and MADEP threshold non-cancer risk limits of an HI of 1.

The non-cancer screening HI for groundwater is 1.5, primarily due to manganese and arsenic. The HQ for each of those analytes is below one. The HQ for naphthalene is very low and does not have a significant impact on the hazard index values. If analytes have different mechanisms of action, it is appropriate to segregate the HQs for the analytes because their effects would not be considered additive (USEPA, 1989).

TABLE 5-5
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
UNRESTRICTED LAND USE - ADULT RESIDENT
STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE PARAMETERS

PARAMETER			
CONCENTRATION SOIL	CS	See Below*	mg/kg
INGESTION RATE	IR	100	mg/day
FRACTION INGESTED	FI	100%	
SOIL ADHERENCE FACTOR	SAF	0.07	mg/cm²
SURFACE AREA EXPOSED	SA	5,700	cm²
CONVERSION FACTOR	CF	0.000001	kg/mg
BODY WEIGHT	BW	70	kg
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	24	years
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	24	years
DERMAL ABSORPTION EFFICIENCY	AE	Chemical-specific	unitless

Notes:
For noncarcinogenic effects: AT = ED
All exposure variables are documented in Table 5-4.

*The lesser of the 95 % upper confidence limit (UCL) & maximum concentration.
ND = Value not determined NE = Route not evaluated

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = (INTAKE-INGESTION) + (INTAKE-DERMAL)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{CS \times SA \times SAF \times AE \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR ORAL (mg/kg-day)-1	CANCER SLOPE FACTOR DERMAL (mg/kg-day)-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK	PERCENT TOTAL RISK
Arsenic	2.2	4.4E-07	0.03	5.3E-08	1.5E+00	1.5E+00	6.6E-07	8.0E-08	7.4E-07	64.23%
Aroclor-1260	0.66	1.3E-07	0.14	7.4E-08	2.0E+00	2.0E+00	2.7E-07	1.5E-07	4.1E-07	35.77%
						SUMMARY CANCER RISK	9.3E-07	2.3E-07	1.2E-06	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE ORAL (mg/kg-day)	REFERENCE DOSE DERMAL (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT	PERCENT TOTAL RISK
Arsenic	2.2	1.3E-06	0.03	1.5E-07	3.0E-04	3.0E-04	4.3E-03	5.2E-04	4.8E-03	13.77%
Aroclor-1260	0.66	3.9E-07	0.14	2.2E-07	2.0E-05	2.0E-05	1.9E-02	1.1E-02	3.0E-02	86.23%
						SUMMARY HAZARD INDEX	2.4E-02	1.1E-02	3.5E-02	

TABLE 5-6
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
UNRESTRICTED LAND USE - ADULT RESIDENT
STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION SOIL*	CS	See below	mg/kg
CONCENTRATION AIR PARTICULATES	CAp	Calculated	mg/m³
CONCENTRATION AIR VOLATILES	CAv	Calculated	mg/m³
VOLATILIZATION FACTOR**	VF	Calculated	m³/kg
PARTICULATE EMISSIONS FACTOR	*PEF*	*1.32E+09*	*ug/m³*
INHALATION RATE	IhR	0.63	m³/hour
BODY WEIGHT	BW	70	kg
EXPOSURE TIME	ET	8	hours/day
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	24	years
RELATIVE ABSORPTION FACTOR	RAF	100%	
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	24	years

Notes: * Soil concentration used is the lesser of the 95 % upper confidence limit (UCL) & maximum concentration
**Volatilization factor used only for volatile chemicals of potential concern.
For noncarcinogenic effects: AT = ED
All exposure variables are documented in Table 5-4.
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE CONCENTRATION (mg/kg-day)

$$\text{INTAKE - INHALATION} = \frac{(CAp + Cav) \times RAF \times IhR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$$

AIR CONCENTRATION PARTICULATES = CS x 1/PEF

AIR CONCENTRATION VOLATILES = CS x 1/VF
(VF not calculated because there are no VOCs selected as CPCs).

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m³/kg)	AIR CONCENTRATION VOLATILES (mg/m³)	AIR CONCENTRATION PARTICULATES (mg/m³)	INTAKE (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)-1	CANCER RISK	PERCENT TOTAL RISK
Arsenic	2.2	NA		1.7E-09	1.7E-11	1.5E+01	2.5E-10	96.15%
Aroclor-1260	0.66	NA		5.0E-10	5.1E-12	2.0E+00	1.0E-11	3.85%
						SUMMARY CANCER RISK	2.6E-10	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m³/kg)	AIR CONCENTRATION VOLATILES (mg/m³)	AIR CONCENTRATION PARTICULATES (mg/m³)	INTAKE (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT	PERCENT TOTAL RISK
Arsenic	2.2	NA		1.7E-09	4.9E-11	ND		
Aroclor-1260	0.66	NA		5.0E-10	1.5E-11	2.0E-05	7.4E-07	100.00%
						SUMMARY HAZARD INDEX	7.4E-07	

TABLE 5-7
INCIDENTAL INGESTION OF AND DERMAL CONTACT WITH SURFACE SOIL - RME
UNRESTRICTED LAND USE - CHILD RESIDENT (1 TO 6 YEARS)
STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION SOIL	CS	See Below*	mg/kg
INGESTION RATE	IR	200	mg/day
FRACTION INGESTED	FI	100%	
SOIL ADHERENCE FACTOR	SAF	0.2	mg/cm²
SURFACE AREA EXPOSED	SA	2,800	cm²
CONVERSION FACTOR	CF	0.000001	kg/mg
BODY WEIGHT	BW	15	kg
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	6	years
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	6	years
DERMAL ABSORPTION EFFICIENCY	AE	Chemical-specific	unitless

Notes:
For noncarcinogenic effects: AT = ED
All exposure variables are documented in Table 5-4.

*The lesser of the 95 % upper confidence limit (UCL) & maximum concentration.
ND = Value not determined NE = Route not evaluated

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = (INTAKE-INGESTION) + (INTAKE-DERMAL)

$$\text{INTAKE-INGESTION} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{CS \times SA \times SAF \times AE \times CF \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR ORAL (mg/kg-day)-1	CANCER SLOPE FACTOR DERMAL (mg/kg-day)-1	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK	PERCENT TOTAL RISK
Arsenic	2.2	1.0E-06	0.03	8.7E-08	1.5E+00	1.5E+00	1.5E-06	1.3E-07	1.7E-06	66.07%
Aroclor-1260	0.66	3.1E-07	0.14	1.2E-07	2.0E+00	2.0E+00	6.2E-07	2.4E-07	8.6E-07	33.93%
						SUMMARY CANCER RISK	2.2E-06	3.7E-07	2.5E-06	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	INTAKE INGESTION (mg/kg-day)	DERMAL ABSORPTION EFFICIENCY	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE ORAL (mg/kg-day)	REFERENCE DOSE DERMAL (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT	PERCENT TOTAL RISK
Arsenic	2.2	1.2E-05	0.03	1.0E-06	3.0E-04	3.0E-04	4.0E-02	3.4E-03	4.4E-02	14.75%
Aroclor-1260	0.66	3.6E-06	0.14	1.4E-06	2.0E-05	2.0E-05	1.8E-01	7.1E-02	2.5E-01	85.25%
						SUMMARY HAZARD INDEX	2.2E-01	7.4E-02	3.0E-01	

TABLE 5-8
INHALATION EXPOSURE TO PARTICULATES IN SURFACE SOIL - RME
UNRESTRICTED LAND USE - CHILD RESIDENT (1 TO 6 YEARS)
STUDY AREA CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION SOIL*	CS	See below	mg/kg
CONCENTRATION AIR PARTICULATES	CAp	Calculated	mg/m³
CONCENTRATION AIR VOLATILES	CAv	Calculated	mg/m³
VOLATILIZATION FACTOR**	VF	Calculated	m³/kg
PARTICULATE EMISSIONS FACTOR	PEF	1.32E+09	ug/m³
INHALATION RATE	IhR	0.35	m³/hour
BODY WEIGHT	BW	15	kg
EXPOSURE TIME	ET	8	hours/day
EXPOSURE FREQUENCY	EF	150	days/year
EXPOSURE DURATION	ED	6	years
RELATIVE ABSORPTION FACTOR	RAF	100%	
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	6	years

Notes: * Soil concentration used is the lesser of the 95 % upper confidence limit (UCL) & maximum concentration
**Volatilization factor used only for volatile chemicals of potential concern.
For noncarcinogenic effects: AT = ED
All exposure variables are documented in Table 5-4.
ND = Value not determined

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE CONCENTRATION (mg/kg-day)

$$\text{INTAKE - INHALATION} = \frac{(CAp + Cav) \times RAF \times IhR \times ET \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$$

AIR CONCENTRATION PARTICULATES = CS x 1/PEF

AIR CONCENTRATION VOLATILES = CS x 1/VF
(VF not calculated because there are no VOCs selected as CPCs).

CARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m³/kg)	AIR CONCENTRATION VOLATILES (mg/m³)	AIR CONCENTRATION PARTICULATES (mg/m³)	INTAKE (mg/kg-day)	CANCER SLOPE FACTOR (mg/kg-day)-1	CANCER RISK	PERCENT TOTAL RISK
Arsenic	2.2	NA		1.7E-09	1.1E-11	1.5E+01	1.6E-10	96.15%
Aroclor-1260	0.66	NA		5.0E-10	3.3E-12	2.0E+00	6.6E-12	3.85%
						SUMMARY CANCER RISK	1.7E-10	

NONCARCINOGENIC EFFECTS

COMPOUND	SOIL CONCENTRATION (mg/kg)	VF (m³/kg)	AIR CONCENTRATION VOLATILES (mg/m³)	AIR CONCENTRATION PARTICULATES (mg/m³)	INTAKE (mg/kg-day)	REFERENCE DOSE (mg/kg-day)	HAZARD QUOTIENT	PERCENT TOTAL RISK
Arsenic	2.2	NA		1.7E-09	1.3E-10	ND		
Aroclor-1260	0.66	NA		5.0E-10	3.8E-11	2.0E-05	1.9E-06	100.00%
						SUMMARY HAZARD INDEX	1.9E-06	

TABLE 5-9
INGESTION OF AND DERMAL CONTACT WITH GROUND WATER - RME
UNRESTRICTED LAND USE - ADULT RESIDENT
STUDY AREA CS-8/FS-21DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE PARAMETERS

PARAMETER	SYMBOL	VALUE	UNITS
CONCENTRATION WATER	CW	maximum	mg/liter
ABSORBED DOSE PER EVENT	DAevent	calculated	mg/cm^2 per event
INGESTION RATE	IR	2	liters/day
FRACTION ABSORBED	FA	Chemical-specific	dimensionless [a]
SURFACE AREA EXPOSED	SA	18,000	cm^2
CONVERSION FACTOR	CF	0.001	liters/cm^3
BODY WEIGHT	BW	70	kg
EVENT TIME	ET	0.58	hours/event
LAG TIME PER EVENT	LT	Chemical-specific	hours/event [a]
EVENT FREQUENCY	EV	1	event/day
EXPOSURE FREQUENCY	EF	350	days/year
EXPOSURE DURATION	ED	30	years
AVERAGING TIME			
CANCER	AT	70	years
NONCANCER	AT	30	years
PERMEABILITY COEFFICIENT	Kpevent	Chemical-specific	cm/hour [b]

Notes:
For noncarcinogenic effects: AT = ED All exposure variables are documented in Table 5-4.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)$^{-1}$

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

INTAKE = (INTAKE-INGESTION) + (INTAKE-DERMAL)

$$\text{INTAKE-INGESTION} = \frac{CW \times IR \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{DAevent \times SA \times EV \times EF \times ED}{BW \times AT \times 365\ days/yr}$$

DAevent (organics) = 2 * FA * CW * Kpevent * SQRT(6 * LT x ET/PI) * CF; PI ~ 3.1416
applicable where ET <= time to reach steady state (hr) = 2.4 * LT

DAevent (organics) = FA * CW * Kpevent * [ET/(1+B) + (2 * LT) * ((1 + 3 * B + 3 * B^2)/(1 + B)^2)] * CF
applicable where ET > time to reach steady state (hr) = 2.4 * LT

DAevent (inorganics) = CW * Kpevent * ET * CF
Source: RAGS Part E Supplemental Guidance for Dermal Risk Assessment; Interim Guidance (EPA, 2000).

CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (mg/L)	INTAKE INGESTION (mg/kg-day)	PERMEABILITY COEFFICIENT (cm/hour)	DA_{EVENT} mg/cm$^{2-event}$	INTAKE DERMAL (mg/kg-day)	CANCER SLOPE FACTOR ORAL (mg/kg-day)$^{-1}$	CANCER SLOPE FACTOR DERMAL (mg/kg-day)$^{-1}$	CANCER RISK INGESTION	CANCER RISK DERMAL	TOTAL CANCER RISK	PERCENT TOTAL RISK
Arsenic	0.0074	8.7E-05	1.0E-03	NE	NE	1.5E+00	1.5E+00	1.3E-04	NE	1.3E-04	100.00%
							SUMMARY CANCER RISK	1.3E-04	0.0E+00	1.3E-04	

NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (mg/L)	INTAKE INGESTION (mg/kg-day)	PERMEABILITY COEFFICIENT (cm/hour)	DA_{EVENT} mg/cm$^{2-event}$	INTAKE DERMAL (mg/kg-day)	REFERENCE DOSE ORAL (mg/kg-day)	REFERENCE DOSE DERMAL (mg/kg-day)	HAZARD QUOTIENT INGESTION	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT	PERCENT TOTAL RISK
Arsenic	0.0074	2.0E-04	1.0E-03	NE	NE	3.0E-04	3.0E-04	6.8E-01	NE	6.8E-01	45.40%
Naphthalene	0.002	5.5E-05	4.9E-02	1.5E-07	3.8E-05	2.0E-02	2.0E-02	2.7E-03	1.9E-03	4.6E-03	0.31%
Manganese	0.708	1.9E-02	1.0E-03	NE	NE	2.4E-02	9.6E-04	8.1E-01	NE	8.1E-01	54.29%
							SUMMARY HAZARD INDEX	1.5E+00	1.9E-03	1.5E+00	

NE = not evaluated for dermal exposure. Per Appendix B, Exhibit B.4 of RAGS Part E Supplemental Guidance for Dermal Risk Assessment (Interim Guidance), arsenic and manganese are not included as chemicals to be assessed for dermal exposure. EPA considers dermal exposure for these compounds to be relatively insignificant compared to ingestion exposures (i.e., dermal dose < 10% ingestion dose).
[a] For naphthalene, FA = 1 and LT = 0.55 hours/event (EPA, 2000 [Appendix B])
[b] Kp values obtained from EPA, 2000 (Exhibit 3.1 for inorganics and Appendix B for organics)

TABLE 5-10
RISK SUMMARY TABLE - POTENTIAL FUTURE LAND USE

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

Exposure Scenario	Population	Medium	Exposure Route		HI	ELCR
Resident - 0-10 ft bgs						
	Child Resident	Soil 0-10 feet bgs	Ingestion		0.2	2.2E-06
			Dermal		0.1	3.7E-07
			Dust Inhalation		0.000002	1.7E-10
					0.3	2.6E-06
	Adult Resident	Soil 0-10 feet bgs	Ingestion		0.02	9.3E-07
			Dermal		0.01	2.3E-07
			Dust Inhalation		0.0000007	2.6E-10
				Soil 0-10 ft bgs	0.03	1.2E-06
		Groundwater*	Ingestion		1.5	1.3E-04
			Dermal contact		0.002	NE
				Groundwater	1.5	1.3E-04
	Child & Adult Resident	Soil 0-10 feet bgs		Total Exposure	0.33	3.8E-06

Notes:
HI - Hazard Index
ELCR - Excess Lifetime Cancer Risk
NE - not evaluated
* Groundwater hazard index is a screening hazard index. Segregated hazard quotients for specific endpoints are all below one.

In this case, the HQs should be segregated. For arsenic, the critical effect is hyperpigmentation, keratosis, and possible vascular complications (IRIS, 2000). For manganese, the critical effect is central nervous system (neurological effects) as reported in IRIS. Because the HQs for arsenic and manganese are each below 1, the risk assessment results indicate that neither the skin-related effects associated with arsenic or the neurological effects associated with manganese are likely. Therefore, the screening HI overestimates the non-cancer risks. The segregated HQs for CPCs in groundwater are appropriate to consider here and they are below 1.

The cumulative cancer risk for groundwater used as potable water is $1.3x10^{-4}$ for the adult resident, which is just above the USEPA cancer risk range of $1x10^{-6}$ to $1x10^{-4}$, and above the MADEP cumulative cancer risk limit of $1x10^{-5}$. However, the risk associated with groundwater is attributable to arsenic. Arsenic was detected in one groundwater well at a concentration (7.4 µg/L) below the Federal and Massachusetts MCL of 50 µg/L, and just above the proposed USEPA MCL of 5 µg/L.

Based on this evaluation, the risks associated with residential use of the surface soil, subsurface soil, and groundwater at Study Area CS-8/FS-21 meet risk management criteria established by USEPA. Cancer risks associated with groundwater exceed the USEPA and MADEP cumulative cancer risk limit due to arsenic; however, the detection of arsenic in groundwater is below the current Federal and Massachusetts drinking water standards.

5.2.4 Uncertainty Assessment

Study-area-specific uncertainties associated with the PRE were identified as follows:

1. Arsenic was not detected at concentrations in surface soil greater than maximum background levels. It was retained as a CPC only because Study Area CS-8/FS-21 maximum surface-soil concentrations exceeded the Region IX residential soil PRG. The residential cancer risk associated with exposure to the maximum background concentration of arsenic ($3x10^{-6}$) is greater than the risk associated with exposure to the maximum concentration detected at the site ($2x10^{-6}$).

2. The conservative nature of the PRE methodology may overestimate potential health risks. For example, arsenic in groundwater was detected

above laboratory detection in just one groundwater sample (04BH001). Groundwater samples collected upgradient (CS-8/MW-2) and downgradient (FS-21/MW-1) of this sample were both below detection limits, yet the arsenic detection in groundwater from borehole 04BH001 (7.4 µg/L) was used to represent the arsenic concentration in groundwater throughout the site in terms of risk.

3. The PRE was conducted using an SI data set that is less comprehensive than an RI data set. Therefore, the human-health PRE may potentially underestimate risk. An SI data set, however, is designed to evaluate the presence of contaminants (worst case scenario). Therefore, it is unlikely that contaminants are present in concentrations that would pose an unacceptable risk.

5.3 ECOLOGICAL PRELIMINARY RISK EVALUATION

The ecological PRE was completed to provide a screening-level evaluation of potential risks that CPCs in surface soil may pose to ecological receptors at Study Areas CS-8/FS-21. PRE methodology is discussed in detail in the RAH (ASG, 1994). The following subsections discuss the PRE and its results.

5.3.1 Data Evaluation

Table 5-11 summarizes the frequencies of detection, the ranges of CRQLs and CRDLs, and the range of detected concentrations of CPCs in surface soil. Ecological CPCs were selected in accordance with steps described in the RAH. Inorganic analytes detected in surface soil at concentrations below MMR background and also below the lowest Tier I and Tier II HECs presented in the RAH were not considered CPCs. In addition, the essential nutrients calcium, iron, magnesium, potassium, and sodium were not retained as CPCs because they have low toxicity and are present at concentrations below MMR background concentrations. As shown in Table 5-11, only zinc was selected as a CPC. The maximum detected concentration of zinc was used in the ecological PRE.

5.3.2 Ecological Exposure Assessment

Study Areas CS-8/FS-21 cover approximately 3 acres and include three buildings for vehicle and equipment maintenance, two concrete wash pads, and two fuel pump islands.

Most of the northern section of the study areas is paved. The unpaved section consists of mowed grass toward the southern end and loose gravel to the west. A chain-link fence borders the site to the north and south. The grassy area contains species typical of a ruderal habitat, such as grasses (Graminae) and herbaceous perennials (e.g., goldenrod [*Solidago* sp.] and bluestem grass [*Andropogon scoparius*]). The majority of the site is paved or covered with crushed rock, and there is a lack of suitable vegetative cover or forage to support most species. Moreover, the frequent human activity at and in the vicinity of the site discourages the presence of wildlife, and the chain-link fence deters larger ecological receptors from entering the site. A pitch-pine/oak woodland, containing characteristic species described in the RAH, is located southwest of the site, beyond the perimeter fence. This wooded area may provide food and cover for small mammals and birds.

The following receptor species, representing a range of taxonomic groups and trophic levels, were used to evaluate risk from surface-soil contamination in the PRE: white-footed mouse (omnivorous small mammal), cardinal (insectivorous small bird), and red fox (omnivorous predatory mammal). These three species were chosen to represent other species within the same trophic level at Study Areas CS-8/FS-21 (ASG, 1994). These three receptors could potentially occur in the nearby woodland and could occasionally use the limited habitat at the study areas. Species-specific ecological exposure parameters used to estimate potential dietary exposure to surface-soil contaminants are in Appendix P of the RAH.

5.3.3 Ecological Effects Assessments

Development of HECs for animal and plant receptors is described in the RAH. HECs for receptor species and Soil Critical Concentration values for phytotoxicity are in Appendices F and O of the RAH, respectively.

5.3.4 Risk Screening

PREs characterize potential ecological risks by comparing maximum site concentrations to pre-calculated, medium-specific HECs or phytotoxicity data. For the ecological PRE, Tier I HECs (based on current exposures) and Tier II HECs (based on future exposures) are the same because exposures of ecological receptors are likely to be similar under current and future land-use conditions (ASG, 1994). Risks to ecological receptors were evaluated by calculating HQs and HIs described in the RAH. The ecological HQ is a receptor- and chemical-specific value equivalent to the ratio of the maximum detected site concentration

TABLE 5-11
ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL

STUDY AREAS CS-8/FS-21 DECISION DOCUMENT
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL	FREQUENCY OF DETECTION	CRQL/ CRDL (mg/kg)	MAXIMUM BACKGROUND CONC. (mg/kg)	HAZARD EQUIVALENT CONCENTRATIONS (mg/kg)			SOIL CRITICAL CONCENTRATION FOR PLANTS (mg/kg)	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	SELECTED AS A CPC?	NOTES
				WHITE-FOOTED	RED FOX	CARDINAL				
SEMIVOLATILE ORGANIC COMPOUNDS										
Bis(2-ethylhexyl)phthalate	1/2	0.33	NA	94.7	3,220	11.2	100	0.064 - 0.064	NO	2
Butylbenzylphthalate	1/2	0.33	NA	11,100	223,000	1,340	11.2	0.14 - 0.14	NO	2
PCBs/PESTICIDES										
Aroclor-1260	1/2	0.16	NA	17.8	29.9	17.6	10	0.66 - 0.66	NO	2
INORGANICS										
Aluminum	2/2	40	8,930	24,200	317,000	54,500	NA	1,300 - 3,220	NO	2, 4
Arsenic	2/2	2	3.6	25.3	762	33.5	5	0.69 - 2.2	NO	4
Barium	2/2	40	10.4	3,900	73,000	1,050	NA	9.6 - 11	NO	2
Beryllium	1/2	1	0.65	34,100	152,000	35,500	NA	0.37 - 0.37	NO	2, 4
Calcium	2/2	1,000	969	NA	NA	NA	NA	218 - 331	NO	3, 4
Chromium	2/2	2	6.8	7.2	185	707	5	2.1 - 5.3	NO	4
Cobalt	1/2	10	4.1	461	2,640	287	15	1.5 - 1.5	NO	2, 4
Copper	1/2	5	5.2	50.8	4,610	12	20	9.2 - 9.2	NO	2
Iron	2/2	20	12,400	NA	NA	NA	NA	2,490 - 4,010	NO	3, 4
Lead	2/2	3	12.05	169	66,100	222	30	5.6 - 6.9	NO	2, 4
Magnesium	2/2	1,000	794.5	NA	NA	222	NA	178 - 536	NO	3, 4
Manganese	2/2	3	108	239	13,200	59.6	300	31 - 59	NO	2, 4
Thallium	1/2	2	0.25	1.28	5.29	2.87	5	0.4 - 0.4	NO	2
Vanadium	2/2	10	15.2	25.9	111	43.8	NA	3.7 - 6.4	NO	2, 4
Zinc	2/2	4	16	32.7	7,720	39.5	100	17 - 30	NO	2

NOTES:
NA = not applicable
CPC = contaminant of potential concern
CRQL = Contract Required Quantitation Limit
CRDL = Contract Required Detection Limit
mg/kg = milligrams per kilogram
Hazard Equivalent Concentration from Appendix F-2 and Soil Phytotoxicity Value from Appendices O-3 and O-4 of the MMR Risk Assessment Handbook (ASG, 1994).
1 Chemical selected as a CPC because maximum detected concentration exceeds HEC and background.
2 Chemical not retained as a CPC because the maximum detected concentration was less than the HEC.
3 Chemical not retained as a CPC because it is an essential nutrient.
4 Chemical not retained as a CPC because the maximum detected concentration was less than the maximum background concentration.

of a particular CPC to the receptor-specific HEC for that particular CPC. The ecological HI is a receptor-specific value equivalent to the sum of all chemical-specific HQs for a given receptor. Separate HIs are calculated for organic and inorganic CPCs. If an HI for a receptor for organics exceeds 1, or for inorganics exceeds 10, the RAH recommends an RI (ASG, 1994). Otherwise, a no-further-action decision can be made.

Surface Soil. A screening-level evaluation of potential risk from surface soil was conducted by using the maximum concentration of the surface-soil analytes detected with species-specific HECs. No analyte concentrations exceeded the HECs.

5.3.5 Ecological Uncertainty Assessment

Several uncertainties are associated with the ecological PRE at Study Areas CS-8/FS-21. Additional general uncertainties inherent in the ecological PRE process are outlined in the RAH. Study-area-specific uncertainties were identified as follows:

1. There is uncertainty associated with the HECs. Several HECs are lower than MMR maximum background concentrations; therefore, some of the risks at the study areas may be attributed to background levels (i.e., natural content of inorganic analytes in soil).

2. Concentrations of inorganics in surface soil were compared to Soil Critical Concentration values for plants. Soil Critical Concentrations were not available for barium. Insufficient data for this analyte adds an uncertainty to the phytotoxicity evaluation for Study Areas CS-8/FS-21.

3. As described in Subsection 5.3.2, Study Areas CS-8/FS-21 contain limited ecological habitat in a semi-urbanized environment. It is unlikely that significant use of these study areas by all ecological receptors evaluated in this PRE will occur.

5.4 SUMMARY OF PRELIMINARY RISK EVALUATION RESULTS

Results of the human-health PRE indicated that arsenic and aroclor-1260 were selected as CPCs in surface soil, arsenic was selected as a CPC in subsurface soil, and naphthalene, arsenic, and manganese were selected as CPCs in groundwater. Health risk calculations for potential resident receptor exposures to the CPCs indicate that risks associated with residential use of the surface soil, subsurface soil, and groundwater at Study Area CS-8/FS-21 meet risk management criteria established by USEPA. Cancer risks associated with groundwater exceed the MADEP cumulative cancer risk limit due to arsenic; however, the detection of arsenic in groundwater is below the current Federal and Massachusetts drinking water standards.

Tiers I and II of the ecological PRE showed that no maximum surface-soil concentrations exceeded the lowest HECs. HIs for all three evaluated receptors did not exceed 1 for organics or 10 for inorganics. Both organic and inorganic HIs for plants were less than 1.

6.0 DRAINAGE STRUCTURE REMOVAL ACTIVITIES

One drainage structure, a cesspool (i.e., 04CDXX1), was removed in April 1996 at Study Areas CS-8/FS-21 as part of the MMR Drainage Structure Removal Program (DSRP) (Jacobs, 1996). The cesspool was located outside the flightline to the west of Building OMS-22, which is located in the Army National Guard Motor Pool area off of South Truck Road. The cesspool walls were constructed of concrete barrel block, with an open dirt bottom and a 4-inch-diameter ceramic inlet pipe. No outlet pipe was present. At the time of removal, the structure had no cover and the walls had collapsed.

No sludge or liquid was removed from the cesspool. The structure and approximately 40 cubic yards of soil and debris were excavated and removed. PI detector screening, sampling and analysis of soils from the open excavation, and backfilling of the excavation were completed following DSRP protocols (Jacobs, 1996). None of the soil analytical results exceeded soil target clean-up levels established for the DSRP; therefore, the cesspool was removed with a clean closure. The Closure Report for the cesspool is included as Appendix D.

7.0 SUMMARY AND CONCLUSIONS

SI efforts at Study Area CS-8/FS-21, which included a soil-gas survey, 10 test pits, six soil borings, four monitoring wells, field-screening of soil samples, and laboratory analysis of soil and groundwater samples, showed no significant contamination of soil or groundwater. Chemical source areas were not found through the soil-gas, test-pit, or soil-boring investigations, and Cesspool 04CDXX1 was removed with a clean closure. Additionally, the former 12,500-gallon diesel fuel UST and the former 5,000-gallon MOGAS UST (i.e., Current Product Tank No. 90) were removed with no evidence of soil contamination during the excavations.

Results of the human-health PRE indicated that arsenic and aroclor-1260 were selected as CPCs in surface soil, arsenic was selected as a CPC in subsurface soil, and naphthalene, arsenic, and manganese were selected as CPCs in groundwater. Health risk calculations for potential resident receptor exposures to the CPCs indicate that risks associated with residential use of the surface soil, subsurface soil, and groundwater at Study Area CS-8/FS-21 meet risk management criteria established by USEPA. Cancer risks associated with groundwater exceed the USEPA and MADEP cumulative cancer risk limit due to arsenic; however, the detection of arsenic in groundwater is below the current Federal and Massachusetts drinking water standards.

Tier I and Tier II of the ecological PRE showed that no maximum surface-soil concentrations exceeded the lowest HECs. HIs for all three evaluated receptors did not exceed 1 for organics or 10 for inorganics. Both organic and inorganic HIs for plants were less than 1.

Therefore, since human-health and ecological risk assessments suggest that unacceptable levels of risk are not anticipated and the potential contaminant source areas have been removed, AFCEE concludes that Study Areas CS-8/FS-21 do not require additional characterization or remediation efforts, and that no further action within the IRP is appropriate.

8.0 DECISION

On the basis of these findings, there is no evidence of significant environmental contamination or of human health or ecological risks at Study Areas CS-8/FS-21. The decision has been made to remove these study areas from further consideration in the IRP process.

GARY M. ERICKSON, P.E.
Director
Air Force Center for Environmental Excellence

19 Oct 00
Date

CS-8/FS 21 DECISION DOCUMENT

U.S. Environmental Protection Agency
New England Division

[✓] Concur

RICHARD CAVAGNERO
Deputy Director
Office of Site Remediation and Restoration

Nov 1, 2000
Date

[ ] Non-concur (please provide reasons _____

CS-8/FS-21 DECISION DOCUMENT

Commonwealth of Massachusetts
Department of Environmental Protection

[✓] Concur

FOR

PAUL A. TAURASI, P.E.
Regional Director
Southeast Region

11-22-00
Date

[ ] Non-concur (please provide reasons): _____

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
20 RIVERSIDE DRIVE, LAKEVILLE, MA 02347 508-946-2700

ARGEO PAUL CELLUCCI
Governor

JANE SWIFT
Lieutenant Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

November 22, 2000

Mr. Robert M. Gill
Remediation Program Manager
HQ AFCEE/MMR
322 East Inner Road
Otis ANG Base, Massachusetts 02542

RE: BOURNE--BWSC-4-0037
Massachusetts Military Reservation (MMR), **Study Area CS-8/FS-21, Final Decision Document,** Concurrence

Dear Mr. Gill:

The Department of Environmental Protection (the "Department") has reviewed a document titled "**DECISION DOCUMENT STUDY AREA CS-8/FS-21, FINAL**" dated October 2000 and prepared by Harding Lawson Associates of Portland, Maine for the Air Force Center for Environmental Excellence (AFCEE).

Study Area CS-8/FS-21 is located on the south side of the intersection of South Outer Road and East Truck Road at the MMR. The Study Area has been operating as the Army National Guard Vehicle Repair Shop since 1950. All underground fuel storage tanks and pump islands have been removed and no contaminants were detected during the removals. A cesspool, the only underground drainage structure, was removed in 1996. Soil and groundwater were tested for all contaminants of concern. Based on current site conditions, the site poses no significant risk of harm to human health or the environment. The DD proposes no further action at Study Area CS-8/FS-21.

The Department concurs with the DD. The Department's concurrence with this DD is based upon representations made to the Department by the AFCEE and assumes that all information provided is substantially complete and accurate. Without limitation, if the Department determines that any material omissions or misstatements exist, if new information becomes available, or if conditions at the Study Area change, resulting in potential or actual human exposure or threats to the environment, the Department reserves its authority under M.G.L. c. 21E, and the MCP, 310 CMR 40.0000 et seq., and any other applicable law or regulation to require further response actions.

Please incorporate this letter into the Administrative Record for the Study Area CS-8/FS-21. If you have any questions regarding this letter, please contact Leonard J. Pinaud at (508) 946-2871.

Sincerely,

FOR
Paul A. Tauràsi, P.E.,
Regional Director

T/LP/HC/mw
c/cs8fs21DDaprv.doc

Cc: DEP-SERO
ATTN: Mildred Garcia-Surette, Deputy Regional Director
Leonard J. Pinaud, Chief, Federal Facilities Remediation Section

Distributions: SERO
SMB
Plume Containment Team
Public Information Team
Long Range Water Supply PAT
Boards of Selectmen
Boards of Health

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
ASG	Automated Sciences Group
BAP	benzo(a)pyrene
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CS	Chemical Spill
CLP	Contract Laboratory Program
CPC	contaminant of potential concern
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
D-BHC	delta-benzene hexachloride
DCE	dichloroethene
DDT	dichlorodiphenyltrichloroethane
DSRP	Drainage Structure Removal Program
EDB	ethylene dibromide
EPC	Exposure Point Concentration
FS	fuel spill
gal/yr	gallons per year
GC	gas chromatograph
HARM	Hazard Assessment Rating Methodology
HEC	hazard equivalent concentration
HI	hazard index
HQ	hazard quotient
IDL	instrument detection limit
IRP	Installation Restoration Program
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
MMR	Massachusetts Military Reservation
MOGAS	motor vehicle gasoline
MSL	mean sea level

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

MTBE	methyl-tert-butyl ether
PA	preliminary assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PI	photoionization
ppm	parts per million
PRG	preliminary remediation goal
PRE	preliminary risk evaluation
QC	quality control
RAH	Risk Assessment Handbook
RI	remedial investigation
SI	site investigation
SMCL	Secondary Maximum Contaminant Level
SQL	sample quantitation limit
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
TPH	total petroleum hydrocarbons
TSDF	Treatment, Storage, and Disposal Facility
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
UTES	Unit Training Equipment Storage
VOC	volatile organic compound
µg/kg	micrograms per kilogram
µg/L	micrograms per liter

ABB Environmental Services, Inc. (ABB-ES), 1992a. "Sump Removal Action Program, Phase I Sump Investigation Program Work Completion Report"; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; October 1992.

ABB Environmental Services, Inc. (ABB-ES), 1992b. "Comprehensive Plan"; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; October 1992.

Admur, M.O., Doull, J., and Klaassen, C.D., 1991, "Casarett and Doull's Toxicology: The Basic Science of Poisons", 4th ed., Pergamon Press; New York, New York.

Automated Sciences Group (ASG), 1994. Risk Assessment Handbook (RAH); prepared for HAZWRAP Support Contractor Office; Oak Ridge, Tennessee.

Berube, L., 1990. Personal communication between Colonel Lou Berube (MMR) and Eugene Shephard (E.C. Jordan Co.) regarding Study Areas CS-8/FS-21; September 21, 1990.

E.C. Jordan Co., 1986. "U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards U.S. Air Force and Veterans Administration Facilities at Massachusetts Military Reservation, Massachusetts, Task 6"; Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 11, 1986.

E.C. Jordan Co., 1989a. "Site Inspection Report Task 2-3A, Field Investigation Work Conducted Fall 1987"; Installation Restoration Program; Massachusetts Military Reservation; March 1989.

E.C. Jordan Co., 1989b. "Task 1-8 Hydrogeologic Summary Report"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; April 1989.

E.C. Jordan Co., 1990a. "Final Site Investigation Report Field Investigation Work Conducted Spring-Summer 1988 Task 2-3B"; prepared for HAZWRAP Support Contractor Office; Oak Ridge, Tennessee.

REFERENCES

E.C. Jordan Co., 1990b. "Site Inspection Report Addendum Task 2-3C, Results of Additional SI Sampling Conducted Summer 1989, Draft"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; May 1990.

E.C. Jordan Co., 1992. "Evaluation of 2-Butanone in Groundwater Samples: Task 2-4, Task 2-5, and Task 2-5B"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; April 1992.

Haase, C.S., B.K. Wallin, and M.S. Miller, 1988. "Evaluation of Methyl Ethyl Ketone (2-Butanone) Contamination at the Massachusetts Military Reservation"; 1988 Department of Energy Model Conference Proceedings; Oak Ridge, Tennessee.

Jacobs Engineering Group, Inc. (Jacobs), 1996. "Drainage Structure Removal Program Closure Report, 04CDXX1, 05CDX14, 23CDXX4, 23CDXX5, and 35CDXX1"; Installation Restoration Program; Otis Air National Guard Base; Cape Cod Massachusetts; August 1996.

Jacobs Engineering Group, Inc. (Jacobs), 1998. "Massachusetts Military Reservation Final Inorganics Investigation Technical Memorandum"; prepared for HQ AFCEE/MMR DEFA Restoration Division, Brooks Air Force Base, TX; June 1998.

Massachusetts Department of Environmental Protection (MADEP), 1999. "Massachusetts Contingency Plan (MCP)"; 310 CMR 40.0000; Commonwealth of Massachusetts; as amended through October 1999.

Massachusetts Department of Environmental Protection (MADEP), 2000. "Drinking Water Standards and Guidelines for Chemicals in Massachusetts Drinking Waters"; Office of Research and Standards; Spring 2000.

Pesce, E., and L. Berube, 1990. Personal communication among Major Ed Pesce (MMR), Colonel Lou Berube (MMR), and Eugene Shephard (ABB-ES) regarding Study Areas CS-8/FS-21; August 6, 1990.

U.S. Environmental Protection Agency (USEPA), 1988. "Region I Laboratory Data Validation: Functional Guidelines for Evaluating Organic Analysis"; prepared for the USEPA Hazardous Site Evaluation Division; Washington, DC; February 1, 1988 (modified November 1988).

U.S. Environmental Protection Agency (USEPA), 1989a. "Region I Laboratory Data Validation: Functional Guidelines for Evaluating Inorganic Analysis"; prepared for the USEPA Hazardous Site Evaluation Division; Washington, DC; June 13, 1988 (modified February 1989).

U.S. Environmental Protection Agency (USEPA), 1989b. "Risk Assessment Guidance for Superfund; Vol. 1, Human Health Evaluation Manual (Part A)"; Office of Emergency and Remedial Response; USEPA 540/1-89/002; Washington, DC; December 1989.

U.S. Environmental Protection Agency (USEPA), 1989c. "Risk Assessment Guidance for Superfund: Environmental Evaluation Manual"; Vol. 2; USEPA 540/1-89/002; Washington, DC; December 1989.

U.S. Environmental Protection Agency (USEPA), 1991. "Risk Assessment Guidance for Superfund, Vol. 1, Part A, Supplemental Guidance, Standard Default Exposure Factors"; Washington, DC.

U.S. Environmental Protection Agency (USEPA), 1992. "Supplemental Guidance to RAGS, Calculating the Concentration Term"; Office of Solid Waste and Emergency Response; Intermittent Bulletin, Vol. 1, No. 1; Washington, D.C.; May 1992.

U.S. Environmental Protection Agency (USEPA), 1993. Integrated Risk Information System (IRIS); On-line Data Base.

U.S. Environmental Protection Agency (USEPA), 1994. "Risk Updates", USEPA Region I, Waste Management Division; No. 2; August 1994.

U.S. Environmental Protection Agency (USEPA), 1995. "Risk Updates"; USEPA Region I, New England, Waste Management Division; No. 3; August 1995.

U.S. Environmental Protection Agency (USEPA), 1996a. "Low Stress Low Flow Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells"; Revision 2; SOP #GW 0001; July 1996.

U.S. Environmental Protection Agency (USEPA), 1996b. "Risk Updates"; USEPA New England, Waste Management Division; No. 4; November 1996.

REFERENCES

U.S. Environmental Protection Agency (USEPA), 1997. "Health Effects Assessment Summary Tables (HEAST), Annual Update"; Office of Solid Waste and Emergency Response; EPA 540/R/97/036; PB97-921199.

U.S. Environmental Protection Agency (USEPA), 1999a. "Risk Updates"; USEPA New England, Waste Management Division; No. 5; September 1997.

U.S. Environmental Protection Agency (USEPA), 1999b. "Preliminary Remediation Goals (PRG) Table"; USEPA Region IX Office of Solid Waste and Emergency Response; October 1999.

U.S. Environmental Protection Agency (USEPA), 2000a. Drinking Water Regulations and Health Advisories; Office of Water; May 2000.

U.S. Environmental Protection Agency (USEPA), 2000b. "Integrated Risk Information System (IRIS)"; on-line database search; February 2000.

U.S. Environmental Protection Agency (USEPA), 2000c. "Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Supplemental Guidance, Part E Dermal Risk Assessment"; Office of Emergency and Remedial Response; Washington, D.C.

APPENDIX A
SUMMARY OF CLP ANALYTICAL DATA

DATA QUALITY ASSESSMENT

The CLP analytical data from Study Areas CS-8/FS-21 were reviewed and evaluated for suitability of use in a risk assessment or as support for engineering studies. Twenty soil samples, all collected in September 1987 as part of the Task 2-3A SI, were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL inorganic analytes, and cyanide. Five of the 20 samples were taken from depths of 10 feet bgs or less. In January 1988, as part of the Task 2-3B SI, samples were collected from four monitoring wells (i.e., CS-8/MW-2, CS-8/MW-4, FS-21/MW-1, and FS-21/MW-2) and analyzed for TCL VOCs and SVOCs, TAL inorganics, and nitrates/nitrites. Duplicate samples were collected from CS-8/MW-2 and CS-8/MW-4. In June 1989, as part of the Task 2-3C SI, one groundwater sample and a duplicate were collected from CS-8/MW-2 and analyzed for TCL VOCs and SVOCs, TAL inorganic analytes, and cyanide.

All Tasks 2-3A, 2-3B, and 2-3C analytical data were CLP data. In preparation for this report, the data were reviewed for holding times, correct methodology, and presence of chemicals in laboratory and field blanks. Corrections for concentrations of chemicals found in any of the associated blanks were applied following USEPA validation guidelines and other guidance (USEPA, 1988, 1989a, and 1989b). For those samples for which associated method blanks or field blanks were not clearly labeled, corrections were applied as determined by the time frame of the sampling and analysis (USEPA, 1989b). The data were not fully validated following USEPA guidance.

The evaluated data were reported with one of four qualifications that affect the suitability for use in a risk assessment:

- an unqualified value — use in risk assessment
- a value with a U; not detected at the SQL — use in risk assessment
- a value with a J; estimated value — use in risk assessment
- R; rejected data — do not use in risk assessment

Based on the evaluation, the data are considered adequate for use in a risk assessment. None of the data were rejected. Much of the data, especially the inorganic analyses, was outside the laboratory method criteria and data validation guidelines, but not so far as to cause the data to be rejected. The identities of these chemicals are not considered uncertain, but the concentrations are considered estimated values and are therefore qualified with a J. Some of the concentrations of the chemicals are estimated (J) because they are below the sample quantitation limit (SQL); that is, the sample-specific instrument detection limit (IDL) for inorganic compounds or the CRQL for organic compounds. As before, the identities of

these chemicals are not considered uncertain but the reported concentrations are. Estimated data (J) are suitable for use in a risk assessment (USEPA, 1989b).

The inorganic data tables available for review from 1987 and 1988 did not report values for detection limits; dashes were used instead. In reviewing the data, the undetected analytes were reported using the SQL based on the CRDL rather than the IDL, qualified with a U. The current validation procedure for reporting undetected inorganics uses the IDL for a value, qualified with a U. Because the CRDL is always higher than the IDL, non-detect values in the older data sets are higher than would have been reported if the IDLs had been known.

As part of the data evaluation, the identities and concentrations of chemicals reported in laboratory method blanks and field blanks (i.e., trip blanks, sampler blanks, equipment rinseates, and source waters) and the effect on the sample results were evaluated. Following USEPA guidance (CLP functional guidelines and USEPA, 1989b), action levels were set for those chemicals detected in the blanks. Only those chemicals whose concentrations exceeded the action levels were considered site-related and not a laboratory or sampling artifact. If the chemical was a common laboratory contaminant as defined by USEPA (i.e., methylene chloride, acetone, 2-butanone, toluene, and phthalates), 10 times the concentration was used for the action level. If the chemical was not a common laboratory contaminant, five times the blank concentration was used for the action level. The individual samples and the laboratory method blanks associated with each are reviewed during evaluation. As part of the data evaluation, blank concentrations over similar time periods were grouped together and concentrations for any samples within that same time period were adjusted following USEPA guidelines (USEPA, 1989b).

VOC ANALYSES

Methylene chloride, acetone, and 2-butanone were the only TCL VOCs detected in either the soil or water samples at Study Areas CS-8/FS-21. All methylene chloride and acetone in the soil samples collected in January 1988 and September/October 1987 are below the action levels of 130 and 500 μg/kg, respectively, based on the maximum concentrations observed in the method blanks (13 μg/kg and 50 μg/L, respectively). No 2-butanone was detected in the soil samples. A single 2-butanone detection at 19 μg/L in a groundwater sample was below the action level of 85 μg/L (based on a blank detection of 8.5 μg/L); it therefore was considered a sampling or analytical artifact and was not reported in the data tables.

Similarly, methylene chloride and acetone were detected but at concentrations below the action levels of 30 and 110 μg/L, respectively, in groundwater samples collected during the June 1989 sampling event. As a result of this evaluation, neither methylene chloride nor acetone is considered a site-related contaminant at Study Areas CS-8/FS-21. They are considered laboratory and sampling artifacts and therefore are not included in the tables.

Detections of 2-butanone during the Task 2-3C SI were above the action levels and do appear in the data tables. Although reported in the data tables, the presence of 2-butanone is considered a sampling artifact resulting from incomplete rinsing of the interior of sampling equipment with distilled water after decontamination with methyl hydrate, which contains approximately 3 percent 2-butanone. The 2-butanone concentrations reported in groundwater samples are not considered representative of those in the aquifer, as was demonstrated previously (E. C. Jordan Co., 1990b and 1992). The 2-butanone is not considered a site-related contaminant.

SVOC ANALYSES

SVOCs detected in samples from Study Areas CS-8/FS-21 are PAHs, bis(2-ethylhexyl)phthalate (BEHP), and butylbenzylphthalate. BEHP and butylbenzylphthalate were detected in one soil sample below the SQL in the Fall 1987 sampling event. Phthalates were not detected in either laboratory or field quality control (QC) samples, according to the Task 2-3A SI report. Consequently, there is no evidence that the phthalates may be considered laboratory or sampling artifacts for this sample.

PAHs were detected in two groundwater samples. Values for the PAH concentrations were estimated and qualified with a J because they were below the SQLs. Naphthalene was detected at 2J μg/L in duplicate samples collected from CS-8/MW-2 in June 1989. However, naphthalene was not detected in duplicate samples collected from the same well in October 1987.

Chrysene, fluoranthene, pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene were detected at concentrations below the SQL in one groundwater sample, JFS21MW202, collected in January 1988. The laboratory was unable to distinguish between benzo(b)fluoranthene and benzo(k)fluoranthene; the value reported represents the sum of the two chemicals. This sample was noted in the sampling log and reported in the SI report to be light brown and contain suspended solids. Monitoring well FS-21/MW-2 is located directly below the MOGAS tank. SVOCs were not detected in the corresponding soil samples from FS-21/TB-2 at 59 to 61 feet. Field-screening for VOCs indicated the possible

presence of benzene, TCE, and others; however, no TCL VOCs, other than known laboratory artifacts, were detected. It is possible that the PAHs detected are laboratory or sampling artifacts and not representative of the groundwater; however, they have been retained for consideration as CPCs.

PESTICIDES AND PCBS

4,4'-DDT and Aroclor-1260 were the only TCL pesticide or PCB detected in any of the soil samples. The pesticide 4,4'-DDT was detected in three soil samples, at 45 μg/kg in FS21TB0259 (at 59 to 61 feet bgs), at 18 μg/kg in CS8XTB0219 (at 19 to 21 feet bgs), and at 24 μg/kg in CS8XTB0254 (at 54 to 56 feet bgs). Aroclor-1260 was detected in one sample at 660 μg/kg in CS8TP0101 (at 1 to 2 feet). Neither 4, 4'-DDT nor Aroclor-1260 was detected in any associated laboratory or field blank; therefore, the 4,4'-DDT and PCB are considered CPCs. None of the groundwater samples were analyzed for TCL pesticides and PCBs.

INORGANIC ANALYSES

Much of the inorganic soil data is qualified as estimated (J) as a result of analyses that are out of criteria for the methods or for results that are below the SQL. The reasons for the estimated qualifier vary and were summarized in the SI and RI reports. None of the inorganic soil data were rejected. Laboratory reports of analyses in the SI and RI reports indicate the type of QC issues. The most common QC issues in the inorganic analyses for Study Areas CS-8/FS-21 data are as follows:

- spiked sample recovery out of control limits (laboratory qualifier N)
- value between the SQL and the IDL (laboratory qualifier [ ])
- matrix interferences, especially for the zinc data (laboratory qualifier E)
- duplicate analyses do not agree within control limits (laboratory qualifier *)

These laboratory qualifiers were changed to J's during the data evaluation. These qualified data are adequate for use in risk assessment.

Zinc was detected in the method blanks associated with groundwater collected in June 1989; none of the zinc in the groundwater samples was above the action limit (i.e., five times the blank concentration). There were no other QC issues reported in the SI reports for the soil or water samples collected in the fall of 1987 and January 1988 (E.C. Jordan Co., 1989a and 1990a).

ANALYTE	SITE	FS21-TB1	FS21-TB1	FS21-TB1	FS21-TB1	FS21-TB1	FS21-TB1	FS21-TB2
	DEPTH	13-15	18-20	28-30	33-35	63-65	63-65	0-2
	ID NUMBER	FS21TB0113	FS21TB0118	FS21TB0128	FS21TB0133	FS21TB0163	FS21TB1D63	FS21TB02X0
	DATE	09/03/87	09/03/87	09/03/87	09/03/87	09/03/87	09/03/87	09/10/87
	MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
INORGANIC ANALYTES (mg/kg)	CRDL							
ARSENIC	2	NR	NR	0.66 J	NR	2 U	0.65 J	2.2
BERYLLIUM	1	NR	NR	1 U	NR	1 U	1.3	1 U
CHROMIUM	2	NR	NR	2 U	NR	2 U	2 U	5.3
COPPER	5	NR	NR	5 U	NR	5 U	6 U	5 U
LEAD	3	NR	NR	1.1	NR	0.72 J	0.79 J	5.6
SELENIUM	1	NR	NR	0.35 J	NR	0.49 J	1 U	1 U
ZINC	4	NR	NR	6.0	NR	6.6	4.1 J	30 J
BARIUM	40	NR	NR	3.2 J	NR	1.2 J	50 U	9.6 J
IRON	20	NR	NR	1300	NR	825	573	4010 J
MANGANESE	3	NR	NR	41 J	NR	8.3 J	5.20 J	31 J
VANADIUM	10	NR	NR	1.9 J	NR	12 U	12 U	6.4 J
ALUMINUM	40	NR	NR	677	NR	352	316 J	3220
MAGNESIUM	1000	NR	NR	251 J	NR	1200 U	1200 U	178 J
CALCIUM	1000	NR	NR	85 J	NR	68 J	75 J	218 J
COBALT	10	NR	NR	-	NR	-	-	11 U
THALLIUM	2	NR	NR	-	NR	-	-	2 U
VOLATILE ORGANIC (ug/kg)								
		-	-	-	-	-	-	-
SEMI-VOLATILE ORGANIC (ug/kg)	CRQL							
BIS(2-ETHYLHEXYL)PHTHALATE	330	NR	NR	340 U	NR	400 U	400 U	64 J
BUTYLBENZYLPHTHALATE	330	NR	NR	340 U	NR	400 U	400 U	140 J
PEST/PCBs (ug/kg)	CRQL							
4,4'-DDT	16	NR	NR	16 U	NR	20 U	20 U	18 U
AROCLOR 1260	160	NR	NR	-	NR	-	-	180 U
PH		NR	NR	6.37	NR	6.22	6.09	6.3
PERCENT SOLIDS		98	98	97	97	81	81	91

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

	SITE	FS21-TB2	FS21-TB2	FS21-TB2
	DEPTH	10-12	39-41	59-61
	ID NUMBER	FS21TB0210	FS21TB0239	FS21TB0259
	DATE	09/10/87	09/10/87	09/10/87
	MATRIX	SOIL	SOIL	SOIL
ANALYTE				
INORGANIC ANALYTES (mg/kg)	CRDL			
ARSENIC	2	2 U	NR	2 U
BERYLLIUM	1	1 U	NR	1 U
CHROMIUM	2	4.3	NR	2 U
COPPER	5	0.94 J	NR	6 U
LEAD	3	1.8	NR	1.1 J
SELENIUM	1	1 U	NR	0.39 J
ZINC	4	8.7 J	NR	9.9 J
BARIUM	40	4.0 J	NR	3.4 J
IRON	20	2020 J	NR	865 J
MANGANESE	3	53 J	NR	56 J
VANADIUM	10	2.0 J	NR	12 U
ALUMINUM	40	914	NR	432
MAGNESIUM	1000	354 J	NR	95 J
CALCIUM	1000	76 J	NR	136 J
COBALT	10	-	NR	-
THALLIUM	2	-	NR	-
VOLATILE ORGANIC (ug/kg)				
		-	-	-
SEMI-VOLATILE ORGANIC (ug/kg)	CRQL			
BIS(2-ETHYLHEXYL)PHTHALATE	330	340 U	NR	380 U
BUTYLBENZYLPHTHALATE	330	340 U	NR	380 U
PEST/PCBs (ug/kg)	CRQL			
4,4'-DDT	16	16 U	NR	45
AROCLOR 1260	160	-	NR	190 U
PH		8.1	NR	6.99
PERCENT SOLIDS		98		86

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

CS8XTBR-APPENDIX

	SITE	CS8-TB2	CS8-TB2	CS8-TB3	CS8-TB3	CS8-TB3	CS8-TB4	CS8-TB4
	DEPTH	54-56	54-56	8-10	18-20	58-60	0-2	5-7
	ID NUMBER	CS8XTB0254	CS8XTBD254	CS8XTB0308	CS8XTB0318	CS8XTB0358	CS8XTB04X0	CS8XTB0405
	DATE	09/01/87	09/01/87	09/01/87	09/01/87	09/01/87	09/04/87	09/04/87
	MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
ANALYTE								
INORGANIC ANALYTES (mg/kg)	CRDL							
ARSENIC	2	2 U	2 U	NR	2 U	2 U	NR	NR
BERYLLIUM	1	1 U	1 U	NR	1 U	1 U	NR	NR
CHROMIUM	2	2 U	2 U	NR	2 U	2 U	NR	NR
COPPER	5	4.3 J	4.3 J	NR	3.5 J	3.6 J	NR	NR
LEAD	3	0.9 J	0.81 J	NR	2.1 J	0.92 J	NR	NR
THALLIUM	2	0.47 J	0.52 J	NR	0.52 J	0.54 J	NR	NR
ZINC	4	7.1 J	8.8 J	NR	7.1 J	5.3	NR	NR
BARIUM	40	1.4 J	1.3 J	NR	1.7 J	1.4 J	NR	NR
IRON	20	822	1060	NR	821 J	416	NR	NR
MANGANESE	3	9.5 J	24 J	NR	27 J	5.4 J	NR	NR
VANADIUM	10	11 U	12 U	NR	10 U	12 U	NR	NR
ALUMINUM	40	409	469	NR	429	225	NR	NR
COBALT	10	10 U	12 U	NR	10 U	12 U	NR	NR
MAGNESIUM	1000	103 J	147 J	NR	83 J	1160 U	NR	NR
CALCIUM	1000	26 J	29 J	NR	23 J	23 J	NR	NR
SELENIUM	1	1 U	1 U	NR	1 U	1 U	NR	NR
VOLATILE ORGANIC (ug/kg)	CRQL	-	-	-	-	-	-	-
SEMI-VOLATILE ORGANIC (ug/kg)	CRQL							
BIS(2-ETHYLHEXYL)PHTHALATE	330	-	-	NR	-	-	NR	NR
BUTYLBENZYLPHTHALATE	330	-	-	NR	-	-	NR	NR
PEST/PCBs (ug/kg)	CRQL							
4,4'-DDT	16	20 U	24	NR	16 U	19 U	NR	NR
PCB-1260	160	200 U	190 U	NR	160 U	190 U	NR	NR
PH		6.66	6.68	NR	6.7	6.84	NR	NR
PERCENT SOLIDS		82	86	98	95	86	91	97

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

CS8XTBR-APPENDIX

	SITE	CS8-TB4	CS8-TB4	CS8-TB4	CS8-TB4
	DEPTH	8-10	10-12	34-36	54-56
	ID NUMBER	CS8XTB0408	CS8XTB0410	CS8XTB0434	CS8XTB0454
	DATE	09/04/87	09/04/87	09/04/87	09/04/87
	MATRIX	SOIL	SOIL	SOIL	SOIL
ANALYTE					
INORGANIC ANALYTES (mg/kg)	CRDL				
ARSENIC	2	NR	0.55 J	0.55 J	0.63 J
BERYLLIUM	1	NR	1 U	1 U	1 U
CHROMIUM	2	NR	2 U	2 U	2 U
COPPER	5	NR	5 U	5 U	5 U
LEAD	3	NR	0.98 J	0.52 J	0.67 J
THALLIUM	2	NR	2 U	2 U	2 U
ZINC	4	NR	5.0	5.0	6.3
BARIUM	40	NR	2.1 J	2.1 J	3.6 J
IRON	20	NR	893 J	583	22 U
MANGANESE	3	NR	46 J	16 J	14 J
VANADIUM	10	NR	1.6 J	10 U	11 U
ALUMINUM	40	NR	551	373	612
COBALT	10	NR	10 U	10 U	11 U
MAGNESIUM	1000	NR	171 J	82 J	148 J
CALCIUM	1000	NR	81 J	63 J	93 J
SELENIUM	1	NR	1 U	0.33 J	11 U
VOLATILE ORGANIC (ug/kg)	CRQL	-	-	-	-
SEMI-VOLATILE ORGANIC (ug/kg)	CRQL				
BIS(2-ETHYLHEXYL)PHTHALATE	330	NR	-	-	-
BUTYLBENZYLPHTHALATE	330	NR	-	-	-
PEST/PCBs (ug/kg)	CRQL				
4,4'-DDT	16	NR	16 U	16 U	16 U
PCB-1260	160	NR	160 U	160 U	160 U
PH		NR	6.13	6.37	5.87
PERCENT SOLIDS		97	97	97	90

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

CS8XTBR-APPENDIX

	SITE	CS8-TP1	CS8-TP6	CS8-TB1	CS8-TB1	CS8-TB1	CS8-TB1	CS8-TB2
	DEPTH	1-2	5-6	23-25	43-45	43-45	58-60	19-21
	ID NUMBER	CS8TP0101	CS8TP0605	CS8XTB0123	CS8XTB0143	CS8XTBD143	CS8XTB0158	CS8XTB0219
	DATE	09/02/87	09/02/87	09/01/87	09/01/87	09/01/87	09/01/87	09/01/87
	MATRIX	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
ANALYTE								
INORGANIC ANALYTES (mg/kg)	CRDL							
ARSENIC	2	0.69 J	2 U	2 U	2 U	2 U	2 U	2 U
BERYLLIUM	1	0.37 J	1 U	1 U	1 U	0.40 J	1 U	1 U
CHROMIUM	2	2.1 J	2 U	2 U	2 U	3.1	2 U	2 U
COPPER	5	9.2 J	4.1 J	3.1 J	3.2 J	3.9 J	4.7 J	3.6 J
LEAD	3	6.9	1.0 J	0.84 J	0.82 J	1.2	0.72 J	0.78 J
THALLIUM	2	0.40 J	0.41 J	0.45 J	0.45 J	0.44 J	0.55 J	0.41 J
ZINC	4	17 J	6.6 J	6.7 J	8.1 J	9.2 J	12 J	7.6 J
BARIUM	40	11 J	1.7 J	1.5 J	2.6 J	4.1 J	2.8 J	1.5 J
IRON	20	2490	961	418	718	2170	979	690
MANGANESE	3	59 J	19 J	10 J	15 J	23 J	53 J	22 J
VANADIUM	10	3.7	10 U	10 U	10 U	2.9 J	11 U	10 U
ALUMINUM	40	1300	647	259	401	925	483	420
COBALT	10	1.5 J	10 U	10 U	10 U	1.30 J	1.5 J	10 U
MAGNESIUM	1000	536 J	129 J	1000 U	95 J	557 J	196 J	1000 U
CALCIUM	1000	331 J	27 J	27 J	36 J	56 J	42 J	27 J
SELENIUM	1	1 U	0.3 U	1 U	1 U	1 U	1 U	1 U
VOLATILE ORGANIC (ug/kg)	CRQL	-	-	-	-	-	-	-
SEMI-VOLATILE ORGANIC (ug/kg)	CRQL							
BIS(2-ETHYLHEXYL)PHTHALATE	330	350 U	340 U	330 U	340 U	340 U	390 U	92 U
BUTYLBENZYLPHTHALATE	330	350 U	340	330 U	340 U	340 U	390 U	340 U
PEST/PCBs (ug/kg)	CRQL							
4,4'-DDT	16	16 U	16 U	16 U	16 U	16 U	19 U	18
PCB-1260	160	660	160 U	160 U	160 U	160 U	190 U	160 U
PH		6.52	6.94	6.53	6.56	6.63	6.61	6.73
PERCENT SOLIDS		94	98	99	97	98	84	97

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

	SITE:	CS8-MW2	CS8-MW2 DUP	CS8-MW4	CS8-MW4 DUP	FS21-MW1	FS21-MW2
	ID NUMBER:	JCS8MW2002	JDUP002X02	JCS8MW4001	JDUP003X01	JFS21MW001	JFS21MW202
	DATE:	01/07/88	01/07/88	10/28/87	10/28/87	10/28/87	01/07/88
	MATRIX:	WATER	WATER	WATER	WATER	WATER	WATER
INORGANIC COMPOUNDS	ANALYTICAL METHOD / CRDL ug/L						
Aluminum	P 200	44 U	200 U	1980	1930	1670	200 U
Arsenic	F 10	2.5 J	2.7 J	3.5 J	2.9 J	10 U	2.9 J
Barium	P 200	37 J	35 J	25 J	25 J	67 J	44 J
Beryllium	P 5	3.6 J	5 U	5 U	5 U	5 U	2 J
Calcium	P 5000	5220	5020	3960 J	5000 U	4600 J	4050 J
Iron	P 100	89 U	78 U	654	607	21 U	10200
Lead	P/F 5	5.2	2.7 J	5 U	2.2 J	9.7 J	3.6 J
Magnesium	P 5000	1200 J	915 J	1250 J	1210 J	1540 J	1080 J
Manganese	P 15	69	66	181	177	281	2700
Potassium	P 5000	2690 J	5000 U	1890 J	3910 J	2110 J	3250 J
Sodium	P 5000	12100	10900	25000 J	24800 J	12000 J	10800
Cobalt	P 50	50 U	50 U	7 U	6.4 U	6.4 U	50 U
VOLATILE ORGANIC COMPOUNDS							
2-Butanone	10	10 U	10 U	10 U	10 U	19 U	NR
SEMI-VOLATILE ORGANIC COMPOUNDS	CRQL ug/L						
Benzo(b)Fluoranthene/Benzo(k)Fluoranthene	10	20 U	20 U	10 U	10 U	10 U	3 J
Chrysene	10	20 U	20 U	10 U	10 U	10 U	2 J
Fluoranthene	10	20 U	20 U	10 U	10 U	10 U	3 J
Pyrene	10	20 U	20 U	10 U	10 U	10 U	3 J
Naphthalene	10	20 U	20 U	10 U	10 U	10 U	20 U
DILUTION FACTOR:		2	2				2
OTHER	RL mg/L						
Nitrate-N	0.040	-	-	-	-	-	-
Nitrite-N	0.020	-	-	-	-	-	-

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

Table 2
Validation / Summary Table

SAMPLE LOCATION:		CS8MW2003	DUP001X03	DUP002X03
LAB NUMBER:		270836	270837	270841
DATE SAMPLED:		06/28/89	06/28/89	06/28/89
DATE ANALYZED:		07/02/89	07/02/89	07/02/89
ANALYTE	CRQL			
Volatile Organic Compounds				
2-Butanone	10	6400	3800	1200
Dilution Factor:		42	29	
Associated Method Blank:		CB890702B23	CB890702B23	
Associated Equipment Blank:		SB002X003	SB002X003	
Associated Trip Blank:		TB002X003	TB002X003	

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

Table 2
Validation / Summary Table

SAMPLE LOCATION:		CS8MW2003	DUP001X03
LAB NUMBER:		270836	270837
DATE SAMPLED:		06/28/89	06/28/89
DATE EXTRACTED:		06/30/89	06/30/89
DATE ANALYZED:		07/02/89	07/02/89
ANALYTE	CRQL		
Naphthalene	10	2 J	2 J
2-Methylnaphthalene	10	10 U	10 U
Acenaphthylene	10	10 U	10 U
Acenaphthene	10	10 U	10 U
Fluorene	10	10 U	10 U
Phenanthrene	10	10 U	10 U
Anthracene	10	10 U	10 U
Fluoranthene	10	10 U	10 U
Pyrene	10	10 U	10 U
Benzo(a)Anthracene	10	10 U	10 U
Chrysene	10	10 U	10 U
Benzo(b)Fluoranthene	10	10 U	10 U
Benzo(k)Fluoranthene	10	10 U	10 U
Benzo(a)Pyrene	10	10 U	10 U
Indeno(1,2,3-cd)pyrene	10	10 U	10 U
Dibenz(a,h)anthracene	10	10 U	10 U
Benzo(g,h,i,)perylene	10	10 U	10 U
Dilution Factor:		1	1
Associated Method Blank:		G3J71066A08	G3J71066A08
Associated Equipment Blank:		SB002X003	SB002X003

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

Table 2
Validation / Summary Table

	SAMPLE LOCATION:	CS8MW2003	DUP001X03
	LAB NUMBER:	270863	270871
	DATE SAMPLED:	06/28/89	06/28/89
ANALYTE	CRDL		
Aluminum	200	180 J	146 J
Arsenic	10	1.2 U	1.2 U
Barium	200	53.4 J	39.3 J
Beryllium	5	0.5 UJ	0.5 UJ
Calcium	5000	4800 J	3670 J
Cobalt	50	12.6 J	13.8 J
Iron	100	2070	2080
Lead	5	1.1 J	2.2 UJ
Magnesium	5000	994 U	996 U
Manganese	15	198	198
Potassium	5000	1740 U	1740 U
Sodium	5000	10200	10800
Associated Method Blank:		17094C	17094C
Associated Equipment Blank:		SB002X003	SB002X003

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

Table 2
Validation / Summary Table

SAMPLE LOCATION:		CS8MW2003	DUP001X03
LAB NUMBER:		270880	270881
DATE SAMPLED:		06/28/89	06/28/89
DATE EXTRACTED:		07/06/89	07/06/89
DATE ANALYZED:		07/08/89	07/08/89
ANALYTE	RL		
Petroleum Hydrocarbons, Total	1	1 U	1 U
Associated Method Blank:		271849	271849
Associated Equipment Blank:		SB002X003	SB002X003

Notes:

1. For data in 1988 and earlier, undetected values for inorganics are indicated by CRDL, qualified with a U.
2. NR = Analysis not requested.
3. In samples not used in the preliminary risk evaluation (PRE), - indicates that compound was undetected.

Appendix A - Additional Groundwater Sampling
CS-8/FS-21 Decision Document

Location	Sample ID	Date	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
FS-21 MW-1													
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	ALUMINUM (TOTAL)	1180	22	100	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	ANTIMONY (TOTAL)	ND	1.9	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	ARSENIC (TOTAL)	ND	1.9	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	BARIUM (TOTAL)	70.4	0.3	20	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	BERYLLIUM (TOTAL)	0.94	0.4	1	UG/L	J
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	CADMIUM (TOTAL)	0.4	0.4	1	UG/L	J
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	CALCIUM (TOTAL)	6030	28.1	500	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	CHROMIUM (TOTAL)	ND	1.2	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	COBALT (TOTAL)	ND	2.6	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	COPPER (TOTAL)	ND	0.8	5	UG/L	UJ
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	IRON (TOTAL)	ND	15.6	100	UG/L	UJ
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	LEAD (TOTAL)	ND	1.1	2	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	MAGNESIUM (TOTAL)	1200	21.8	500	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	MANGANESE (TOTAL)	708	0.3	10	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	NICKEL (TOTAL)	ND	3.8	20	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	POTASSIUM (TOTAL)	1300	46.3	1500	UG/L	J
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	SELENIUM (TOTAL)	ND	2.7	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	SILVER (TOTAL)	ND	0.95	10	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	SODIUM (TOTAL)	21700	98.8	500	UG/L	
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	THALLIUM (TOTAL)	ND	2.5	10	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	VANADIUM (TOTAL)	ND	1	10	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C200.7	TOTAL	ZINC (TOTAL)	19.3	1.9	20	UG/L	J
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	C245.2	TOTAL	MERCURY (TOTAL)	ND	0.012	0.2	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,1,1-TRICHLOROETHANE	ND	0.21	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,1,2,2-TETRACHLOROETHANE	ND	0.18	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,1,2-TRICHLOROETHANE	ND	0.23	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,1-DICHLOROETHANE	ND	0.19	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,1-DICHLOROETHENE	ND	0.21	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2,4-TRICHLOROBENZENE	ND	0.31	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.37	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.22	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2-DICHLOROBENZENE	ND	0.26	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2-DICHLOROETHANE	ND	0.18	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,2-DICHLOROPROPANE	ND	0.15	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,3-DICHLOROBENZENE	ND	0.24	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	1,4-DICHLOROBENZENE	ND	0.2	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	2-HEXANONE	ND	0.87	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	ACETONE	ND	0.82	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	BENZENE	ND	0.19	1	UG/L	U

Appendix A - Additional Groundwater Sampling
CS-8/FS-21 Decision Document

Location	Sample ID	Date	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	BROMOCHLOROMETHANE	ND	0.23	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	BROMODICHLOROMETHANE	ND	0.19	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	BROMOFORM	ND	0.27	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	BROMOMETHANE	ND	0.16	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CARBON DISULFIDE	ND	0.21	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CARBON TETRACHLORIDE	ND	0.16	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CHLOROBENZENE	ND	0.19	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CHLOROETHANE	ND	0.19	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CHLOROFORM	ND	0.16	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CHLOROMETHANE	ND	0.18	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CIS-1,2-DICHLOROETHYLENE	ND	0.2	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	CIS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	DIBROMOCHLOROMETHANE	ND	0.24	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	ETHYLBENZENE	ND	0.18	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	METHYL ETHYL KETONE (2-BUTANONE)	ND	0.97	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	METHYL ISOBUTYL KETONE (4-METHYL-2-	ND	0.81	5	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	METHYLENE CHLORIDE	ND	0.19	2	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	STYRENE	ND	0.17	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TERT-BUTYL METHYL ETHER	ND	0.17	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TETRACHLOROETHYLENE(PCE)	ND	0.35	1.7	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TOLUENE	ND	0.19	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TRANS-1,2-DICHLOROETHENE	ND	0.18	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TRANS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	TRICHLOROETHYLENE (TCE)	ND	0.16	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	VINYL CHLORIDE	ND	0.14	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	CVOL	METHOD	XYLENES, TOTAL	ND	0.2	1	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	E504	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.0045	0.01	UG/L	U
04MW0001	04MW0001-02	3/10/99	60.1	N1	WG	E504	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.0047	0.01	UG/L	U
CS-8 MW-2													
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	ALUMINUM (TOTAL)	ND	80.1	100	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	ANTIMONY (TOTAL)	ND	1.9	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	ARSENIC (TOTAL)	ND	1.9	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	BARIUM (TOTAL)	17.2	0.3	20	UG/L	J
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	BERYLLIUM (TOTAL)	ND	0.4	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	CADMIUM (TOTAL)	0.35	0.4	1	UG/L	J
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	CALCIUM (TOTAL)	2590	28.1	500	UG/L	
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	CHROMIUM (TOTAL)	ND	1.2	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	COBALT (TOTAL)	ND	0.6	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	COPPER (TOTAL)	ND	0.8	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	IRON (TOTAL)	ND	83.5	100	UG/L	U

Appendix A - Additional Groundwater Sampling
CS-8/FS-21 Decision Document

Location	Sample ID	Date	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	LEAD (TOTAL)	ND	1.1	2	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	MAGNESIUM (TOTAL)	287	21.8	500	UG/L	J
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	MANGANESE (TOTAL)	34.1	0.3	10	UG/L	
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	NICKEL (TOTAL)	ND	1.9	20	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	POTASSIUM (TOTAL)	1120	46.3	1500	UG/L	J
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	SELENIUM (TOTAL)	ND	2.7	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	SILVER (TOTAL)	ND	0.59	10	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	SODIUM (TOTAL)	18800	98.8	500	UG/L	
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	THALLIUM (TOTAL)	ND	2.5	10	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	VANADIUM (TOTAL)	ND	1	10	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C200.7	TOTAL	ZINC (TOTAL)	ND	4.2	20	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	C245.2	TOTAL	MERCURY (TOTAL)	ND	0.025	0.2	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,1,1-TRICHLOROETHANE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,1,2,2-TETRACHLOROETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,1,2-TRICHLOROETHANE	ND	0.23	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,1-DICHLOROETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,1-DICHLOROETHENE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2,4-TRICHLOROBENZENE	ND	0.31	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.37	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.22	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2-DICHLOROBENZENE	ND	0.26	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2-DICHLOROETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,2-DICHLOROPROPANE	ND	0.15	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,3-DICHLOROBENZENE	ND	0.24	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	1,4-DICHLOROBENZENE	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	2-HEXANONE	ND	0.87	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	ACETONE	ND	0.82	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	BENZENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	BROMOCHLOROMETHANE	ND	0.23	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	BROMODICHLOROMETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	BROMOFORM	ND	0.27	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	BROMOMETHANE	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CARBON DISULFIDE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CARBON TETRACHLORIDE	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CHLOROBENZENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CHLOROETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CHLOROFORM	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CHLOROMETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CIS-1,2-DICHLOROETHYLENE	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	CIS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	DIBROMOCHLOROMETHANE	ND	0.24	1	UG/L	U

Appendix A - Additional Groundwater Sampling
CS-8/FS-21 Decision Document

Location	Sample ID	Date	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	ETHYLBENZENE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	METHYL ETHYL KETONE (2-BUTANONE)	ND	0.97	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	METHYL ISOBUTYL KETONE (4-METHYL-2-	ND	0.81	5	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	METHYLENE CHLORIDE	ND	0.19	2	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	STYRENE	ND	0.17	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TERT-BUTYL METHYL ETHER	ND	0.17	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TETRACHLOROETHYLENE(PCE)	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TOLUENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TRANS-1,2-DICHLOROETHENE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TRANS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	TRICHLOROETHYLENE (TCE)	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	VINYL CHLORIDE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	CVOL	METHOD	XYLENES, TOTAL	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	E504	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.0045	0.01	UG/L	U
04MW0002	04MW0002-03	3/10/99	60	N1	WG	E504	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.0047	0.01	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	ALUMINUM (TOTAL)	ND	65.1	100	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	ANTIMONY (TOTAL)	ND	1.9	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	ARSENIC (TOTAL)	ND	1.9	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	BARIUM (TOTAL)	17.1	0.3	20	UG/L	J
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	BERYLLIUM (TOTAL)	ND	0.4	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	CADMIUM (TOTAL)	0.62	0.4	1	UG/L	J
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	CALCIUM (TOTAL)	2620	28.1	500	UG/L	
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	CHROMIUM (TOTAL)	ND	2.01	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	COBALT (TOTAL)	ND	0.6	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	COPPER (TOTAL)	ND	0.8	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	IRON (TOTAL)	ND	67.3	100	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	LEAD (TOTAL)	ND	1.1	2	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	MAGNESIUM (TOTAL)	280	21.8	500	UG/L	J
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	MANGANESE (TOTAL)	35.2	0.3	10	UG/L	
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	NICKEL (TOTAL)	ND	1.9	20	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	POTASSIUM (TOTAL)	1180	46.3	1500	UG/L	J
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	SELENIUM (TOTAL)	ND	2.7	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	SILVER (TOTAL)	ND	1.9	10	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	SODIUM (TOTAL)	19000	98.8	500	UG/L	
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	THALLIUM (TOTAL)	ND	2.5	10	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	VANADIUM (TOTAL)	ND	1	10	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C200.7	TOTAL	ZINC (TOTAL)	8.4	1.9	20	UG/L	J
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	C245.2	TOTAL	MERCURY (TOTAL)	ND	0.026	0.2	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,1,1-TRICHLOROETHANE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,1,2,2-TETRACHLOROETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,1,2-TRICHLOROETHANE	ND	0.23	1	UG/L	U

Appendix A - Additional Groundwater Sampling
CS-8/FS-21 Decision Document

Location	Sample ID	Date	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,1-DICHLOROETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,1-DICHLOROETHENE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2,4-TRICHLOROBENZENE	ND	0.31	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.37	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.22	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2-DICHLOROBENZENE	ND	0.26	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2-DICHLOROETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,2-DICHLOROPROPANE	ND	0.15	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,3-DICHLOROBENZENE	ND	0.24	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	1,4-DICHLOROBENZENE	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	2-HEXANONE	ND	0.87	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	ACETONE	ND	0.82	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	BENZENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	BROMOCHLOROMETHANE	ND	0.23	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	BROMODICHLOROMETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	BROMOFORM	ND	0.27	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	BROMOMETHANE	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CARBON DISULFIDE	ND	0.21	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CARBON TETRACHLORIDE	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CHLOROBENZENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CHLOROETHANE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CHLOROFORM	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CHLOROMETHANE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CIS-1,2-DICHLOROETHYLENE	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	CIS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	DIBROMOCHLOROMETHANE	ND	0.24	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	ETHYLBENZENE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	METHYL ETHYL KETONE (2-BUTANONE)	ND	0.97	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	METHYL ISOBUTYL KETONE (4-METHYL-2-	ND	0.81	5	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	METHYLENE CHLORIDE	ND	0.19	2	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	STYRENE	ND	0.17	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TERT-BUTYL METHYL ETHER	ND	0.17	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TETRACHLOROETHYLENE(PCE)	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TOLUENE	ND	0.19	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TRANS-1,2-DICHLOROETHENE	ND	0.18	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TRANS-1,3-DICHLOROPROPENE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	TRICHLOROETHYLENE (TCE)	ND	0.16	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	VINYL CHLORIDE	ND	0.14	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	CVOL	METHOD	XYLENES, TOTAL	ND	0.2	1	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	E504	METHOD	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.0045	0.01	UG/L	U
04MW0002	04MW0002-03FD	3/10/99	60	FD1	WG	E504	METHOD	1,2-DIBROMOETHANE (EDB)	ND	0.0047	0.01	UG/L	U

Attachment A
CS-8/FS-21 Groundwater Monitoring Results

Location	Date	Analyte	Result	DL	RL	Units	Qualifier
04BH0001	12/14/99	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.0017	0.01	µg/L	U
04BH0001	12/14/99	1,2-DIBROMOETHANE (EDB)	ND	0.0083	0.01	µg/L	U
04BH0001	12/14/99	ANTIMONY (TOTAL)	ND	4.5	60	µg/L	U
04BH0001	12/14/99	ARSENIC (TOTAL)	7.4	3.9	10	µg/L	J
04BH0001	12/14/99	BERYLLIUM (TOTAL)	ND	0.7	5	µg/L	UJ
04BH0001	12/14/99	CADMIUM (TOTAL)	ND	0.4	5	µg/L	UJ
04BH0001	12/14/99	CHROMIUM (TOTAL)	ND	0.7	10	µg/L	U
04BH0001	12/14/99	COPPER (TOTAL)	ND	2	25	µg/L	U
04BH0001	12/14/99	NICKEL (TOTAL)	ND	1.4	40	µg/L	UJ
04BH0001	12/14/99	SELENIUM (TOTAL)	ND	3.6	5	µg/L	U
04BH0001	12/14/99	SILVER (TOTAL)	ND	0.8	10	µg/L	U
04BH0001	12/14/99	ZINC (TOTAL)	29.6	0.4	20	µg/L	
04BH0001	12/14/99	LEAD (TOTAL)	ND	6	15	µg/L	U
04BH0001	12/14/99	LEAD (TOTAL)	ND	6	15	µg/L	U
04BH0001	12/14/99	MERCURY (TOTAL)	ND	0.1	0.2	µg/L	U
04BH0001	12/14/99	THALLIUM (TOTAL)	ND	1.7	2	µg/L	U
04BH0001	12/14/99	THALLIUM (TOTAL)	ND	1.7	2	µg/L	U
04BH0001	12/14/99	BENZO(B)FLUORANTHENE	ND	0.023	0.1	µg/L	U
04BH0001	12/14/99	BENZO(K)FLUORANTHENE	ND	0.023	0.1	µg/L	U
04BH0001	12/14/99	2,2'-OXYBIS(1-CHLORO)PROPANE	ND	3.27	4.81	µg/L	U
04BH0001	12/14/99	2,4,5-TRICHLOROPHENOL	ND	2.02	19.2	µg/L	U
04BH0001	12/14/99	2,4,6-TRICHLOROPHENOL	ND	2.21	4.81	µg/L	U
04BH0001	12/14/99	2,4-DICHLOROPHENOL	ND	2.6	4.81	µg/L	U
04BH0001	12/14/99	2,4-DIMETHYLPHENOL	ND	2.4	4.81	µg/L	U
04BH0001	12/14/99	2,4-DINITROPHENOL	ND	2.5	19.2	µg/L	U
04BH0001	12/14/99	2,4-DINITROTOLUENE	ND	1.92	4.81	µg/L	U
04BH0001	12/14/99	2,6-DINITROTOLUENE	ND	1.44	4.81	µg/L	U
04BH0001	12/14/99	2-CHLORONAPHTHALENE	ND	2.79	4.81	µg/L	U
04BH0001	12/14/99	2-CHLOROPHENOL	ND	3.08	4.81	µg/L	U
04BH0001	12/14/99	2-METHYLNAPHTHALENE	ND	2.98	4.81	µg/L	U
04BH0001	12/14/99	2-METHYLPHENOL (O-CRESOL)	ND	2.88	4.81	µg/L	U
04BH0001	12/14/99	2-NITROANILINE	ND	1.64	19.2	µg/L	U
04BH0001	12/14/99	2-NITROPHENOL	ND	2.96	4.81	µg/L	U
04BH0001	12/14/99	3,3'-DICHLOROBENZIDINE	ND	2.88	4.81	µg/L	U
04BH0001	12/14/99	3-NITROANILINE	ND	2.02	19.2	µg/L	U
04BH0001	12/14/99	4,6-DINITRO-2-METHYLPHENOL	ND	2.6	19.2	µg/L	U

CS-8/FS-21 Groundwater Monitoring Results

Location	Date	Analyte	Result	DL	RL	Units	Qualifier
04BH0001	12/14/99	4-BROMOPHENYL PHENYL ETHER	ND	2.21	4.81	µg/L	U
04BH0001	12/14/99	4-CHLORO-3-METHYLPHENOL	ND	2.12	4.81	µg/L	U
04BH0001	12/14/99	4-CHLOROANILINE	ND	2.5	4.81	µg/L	UJ
04BH0001	12/14/99	4-CHLOROPHENYL PHENYL ETHER	ND	1.64	4.81	µg/L	U
04BH0001	12/14/99	4-METHYLPHENOL (P-CRESOL)	ND	2.69	4.81	µg/L	U
04BH0001	12/14/99	4-NITROANILINE	ND	4.14	19.2	µg/L	U
04BH0001	12/14/99	4-NITROPHENOL	ND	4.04	19.2	µg/L	U
04BH0001	12/14/99	ACENAPHTHENE	ND	2.12	4.81	µg/L	U
04BH0001	12/14/99	ACENAPHTHYLENE	ND	2.21	4.81	µg/L	U
04BH0001	12/14/99	ANTHRACENE	ND	1.64	4.81	µg/L	U
04BH0001	12/14/99	BENZO(A)ANTHRACENE	ND	0.865	4.81	µg/L	U
04BH0001	12/14/99	BENZO(A)PYRENE	-	-	-	µg/L	R
04BH0001	12/14/99	BENZO(B)FLUORANTHENE	ND	1.35	4.81	µg/L	U
04BH0001	12/14/99	BENZO(G,H,I)PERYLENE	ND	3.08	4.81	µg/L	U
04BH0001	12/14/99	BENZO(K)FLUORANTHENE	ND	1.25	4.81	µg/L	U
04BH0001	12/14/99	BENZYL BUTYL PHTHALATE	ND	1.25	4.81	µg/L	U
04BH0001	12/14/99	BIS(2-CHLOROETHOXY) METHANE	ND	3.17	4.81	µg/L	U
04BH0001	12/14/99	BIS(2-CHLOROETHYL) ETHER	ND	3.36	4.81	µg/L	U
04BH0001	12/14/99	BIS(2-ETHYLHEXYL) PHTHALATE	ND	3.75	4.81	µg/L	U
04BH0001	12/14/99	CHRYSENE	ND	1.06	4.81	µg/L	U
04BH0001	12/14/99	DI-N-BUTYL PHTHALATE	ND	1.92	4.81	µg/L	U
04BH0001	12/14/99	DI-N-OCTYLPHTHALATE	ND	3.17	4.81	µg/L	U
04BH0001	12/14/99	DIBENZ(A,H)ANTHRACENE	ND	2.6	4.81	µg/L	U
04BH0001	12/14/99	DIBENZOFURAN	ND	1.92	4.81	µg/L	U
04BH0001	12/14/99	DIETHYL PHTHALATE	ND	1.25	4.81	µg/L	U
04BH0001	12/14/99	DIMETHYL PHTHALATE	ND	1.83	4.81	µg/L	U
04BH0001	12/14/99	FLUORANTHENE	ND	1.44	4.81	µg/L	U
04BH0001	12/14/99	FLUORENE	ND	1.64	4.81	µg/L	U
04BH0001	12/14/99	HEXACHLOROBENZENE	ND	2.02	4.81	µg/L	U
04BH0001	12/14/99	HEXACHLOROBUTADIENE	ND	3.27	4.81	µg/L	U
04BH0001	12/14/99	HEXACHLOROCYCLOPENTADIENE	ND	1.06	4.81	µg/L	U
04BH0001	12/14/99	HEXACHLOROETHANE	ND	3.36	4.81	µg/L	U
04BH0001	12/14/99	INDENO(1,2,3-C,D)PYRENE	ND	2.6	4.81	µg/L	U
04BH0001	12/14/99	ISOPHORONE	ND	2.88	4.81	µg/L	U
04BH0001	12/14/99	N-NITROSODI-N-PROPYLAMINE	ND	3.17	4.81	µg/L	UJ
04BH0001	12/14/99	N-NITROSODIPHENYLAMINE	ND	1.54	4.81	µg/L	UJ

Attachment A
CS-8/FS-21 Groundwater Monitoring Results

Location	Date	Analyte	Result	DL	RL	Units	Qualifier
04BH0001	12/14/99	NAPHTHALENE	ND	2.98	4.81	µg/L	U
04BH0001	12/14/99	NITROBENZENE	ND	3.17	4.81	µg/L	U
04BH0001	12/14/99	PENTACHLOROPHENOL	ND	2.31	19.2	µg/L	U
04BH0001	12/14/99	PHENANTHRENE	ND	1.64	4.81	µg/L	U
04BH0001	12/14/99	PHENOL	ND	3.08	4.81	µg/L	U
04BH0001	12/14/99	PYRENE	ND	1.83	4.81	µg/L	U
04BH0001	12/14/99	1,1,1-TRICHLOROETHANE	ND	0.23	1	µg/L	U
04BH0001	12/14/99	1,1,2,2-TETRACHLOROETHANE	ND	0.32	1	µg/L	U
04BH0001	12/14/99	1,1,2-TRICHLOROETHANE	ND	0.33	1	µg/L	U
04BH0001	12/14/99	1,1-DICHLOROETHANE	ND	0.29	1	µg/L	U
04BH0001	12/14/99	1,1-DICHLOROETHENE	ND	0.3	1	µg/L	U
04BH0001	12/14/99	1,2,4-TRICHLOROBENZENE	ND	0.31	1	µg/L	U
04BH0001	12/14/99	1,2-DIBROMO-3-CHLOROPROPANE	ND	0.43	1	µg/L	U
04BH0001	12/14/99	1,2-DIBROMOETHANE (EDB)	ND	0.28	1	µg/L	U
04BH0001	12/14/99	1,2-DICHLOROBENZENE	ND	0.24	1	µg/L	U
04BH0001	12/14/99	1,2-DICHLOROETHANE	ND	0.3	1	µg/L	U
04BH0001	12/14/99	1,2-DICHLOROPROPANE	ND	0.31	1	µg/L	U
04BH0001	12/14/99	1,3-DICHLOROBENZENE	ND	0.25	1	µg/L	U
04BH0001	12/14/99	1,4-DICHLOROBENZENE	ND	0.26	1	µg/L	U
04BH0001	12/14/99	2-HEXANONE	-	-	-	µg/L	R
04BH0001	12/14/99	ACETONE	-	-	-	µg/L	R
04BH0001	12/14/99	BENZENE	ND	0.28	1	µg/L	U
04BH0001	12/14/99	BROMOCHLOROMETHANE	ND	0.3	1	µg/L	U
04BH0001	12/14/99	BROMODICHLOROMETHANE	ND	0.25	1	µg/L	U
04BH0001	12/14/99	BROMOFORM	ND	0.26	1	µg/L	U
04BH0001	12/14/99	BROMOMETHANE	ND	0.28	1	µg/L	U
04BH0001	12/14/99	CARBON DISULFIDE	ND	0.29	1	µg/L	U
04BH0001	12/14/99	CARBON TETRACHLORIDE	ND	0.27	1	µg/L	U
04BH0001	12/14/99	CHLOROBENZENE	ND	0.25	1	µg/L	U
04BH0001	12/14/99	CHLOROETHANE	ND	0.27	1	µg/L	U
04BH0001	12/14/99	CHLOROFORM	ND	0.29	1	µg/L	U
04BH0001	12/14/99	CHLOROMETHANE	ND	0.28	1	µg/L	U
04BH0001	12/14/99	CIS-1,2-DICHLOROETHENE	ND	0.24	1	µg/L	U
04BH0001	12/14/99	CIS-1,3-DICHLOROPROPENE	ND	0.32	1	µg/L	U
04BH0001	12/14/99	DIBROMOCHLOROMETHANE	ND	0.28	1	µg/L	U
04BH0001	12/14/99	ETHYLBENZENE	1.14	0.21	1	µg/L	

CS-8/FS-21 Groundwater Monitoring Results

Location	Date	Analyte	Result	DL	RL	Units	Qualifier
04BH0001	12/14/99	METHYL ETHYL KETONE (2-BUTANONE)	-	-	-	µg/L	R
04BH0001	12/14/99	METHYL ISOBUTYL KETONE	ND	1.42	5	µg/L	U
04BH0001	12/14/99	METHYL-TERT-BUTYL-ETHER (MTBE)	ND	0.45	1	µg/L	U
04BH0001	12/14/99	METHYLENE CHLORIDE	ND	0.28	2	µg/L	U
04BH0001	12/14/99	STYRENE	ND	0.26	1	µg/L	U
04BH0001	12/14/99	TETRACHLOROETHENE(PCE)	ND	0.22	1	µg/L	U
04BH0001	12/14/99	TOLUENE	ND	0.29	1	µg/L	U
04BH0001	12/14/99	TRANS-1,2-DICHLOROETHENE	ND	0.24	1	µg/L	U
04BH0001	12/14/99	TRANS-1,3-DICHLOROPROPENE	ND	0.44	1	µg/L	U
04BH0001	12/14/99	TRICHLOROETHENE(TCE)	ND	0.35	1	µg/L	U
04BH0001	12/14/99	VINYL CHLORIDE	ND	0.27	1	µg/L	U
04BH0001	12/14/99	XYLENES, TOTAL	3.04	0.79	1	µg/L	

DL = detection limit
RL = reporting limit
ND = nondetect
µg/L = micrograms per liter
U = concentration of analyte is below detection limit
J = estimated concentration
UJ = concentration of analyte is estimated to be below detection limit
R = rejected

Attachment A
CS-8/FS-21 Groundwater Monitoring Results

Location	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation/Reduction Potential (mV)	Specific Conductance (µS/cm)	pH (SU)
04BH0001	12/14/99	11.48	0.41	7.90	155.70	124.00	6.18

°C = degrees centigrade
mg/L = milligrams per liter
NTU = nephelometric turbidity units
mV = millivolts
µS/cm = microsiemens per centimeter
SU = standard units

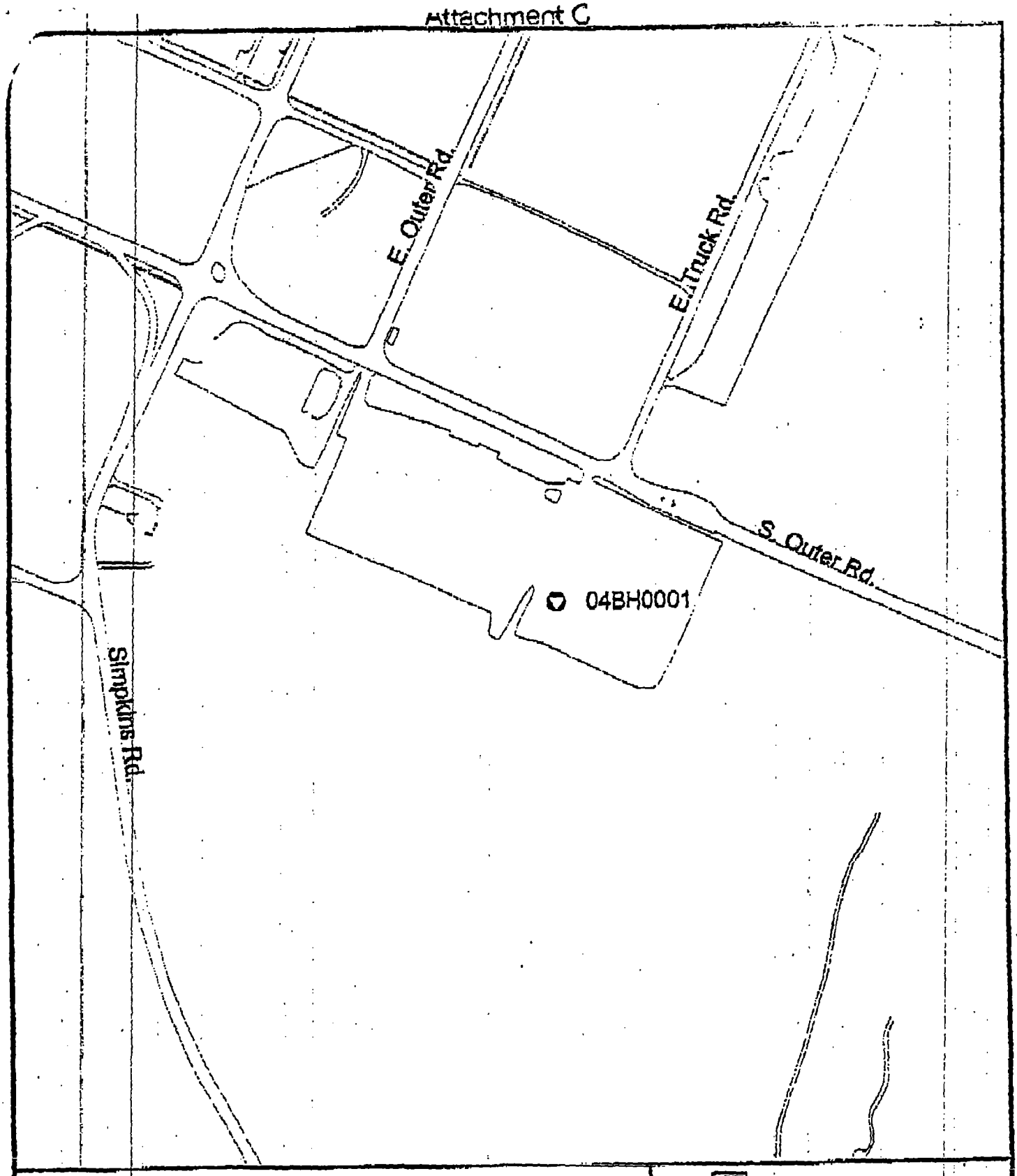
Attachment

CS-8/FS-21 Sample Information

Well Identification	Date Sampled	Ground Surface Elevation (ft msl)	Sample Elevation (ft msl)	Groundwater Elevation (ft msl)	Northing Coordinate on Surface (feet)	Easting Coordinate on Surface (feet)
04BH0001	14-Dec-99	107.21	35.01 - 40.01	50.21	237008.12	862883.32

Elevation is measured in feet mean sea level (ft msl).

Attachment C



Legend

Borehole

0 300

Scale in Feet

JACOBS ENGINEERING

CS-8 / FS-21 Study Area
Groundwater Sampling Location

Massachusetts Military Reservation
Cape Cod, Massachusetts

2/14/03 ma File...Dc22-Source.dwg

Figure 1

APPENDIX B
SUMMARY OF FIELD LABORATORY ANALYTICAL DATA FOR TERRAPROBE BORINGS

PHASE I SUMP REMOVAL ACTION PROGRAM - MASSACHUSETTS MILITARY RESERVATION

Parameter	Site: CS-8/CD-1 Matr: SOIL Dpth: 4 ISIS: 04TRX11XX4X1XF Date: 28-FEB-92	CS-8/CD-1 SOIL 8 04TRX11XX8X1XF 28-FEB-92	CS-8/CD-1 SOIL 12 04TRX11X12X1XF 28-FEB-92	CS-8/CD-1 SOIL 18 04TRX11X18X1XF 28-FEB-92	CS-8/CD-1 SOIL 24 04TRX11X24X1XF 28-FEB-92	CS-8/CD-1 SOIL 4 04TRX12XX4X1XF 28-FEB-92	CS-8/CD-1 SOIL 8 04TRX12XX8X1DF 28-FEB-92	CS-8/CD-1 SOIL 8 04TRX12XX8X1XF 28-FEB-92
PI meter reading (ppm)	1.3	0.0	0.0	0.6	0.0	0.0	1.2	1.2
VOCs (ug/kg)								
Toluene	ND	ND	ND	ND	ND	ND	130	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	190	ND
o-Xylene	ND	ND	ND	ND	ND	ND	67	ND
m/p-Xylene	ND	ND	ND	ND	ND	ND	250	ND
SVOCs **(ug/kg)**	ND	ND	ND	ND	ND	ND	ND	ND
Pest/PCBs (ug/kg)								
Delta-BHC	ND	ND	ND	ND	ND	ND	330	530
Heptachlor epoxide	ND	ND	ND	ND	ND	140	1700	1800
Inorganics (mg/kg)								
Lead	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	ND	ND	ND	ND	270	ND
Zinc	ND	ND	ND	ND	ND	ND	380	ND
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	ND
TPH (mg/kg)	130	83	84	120	120	130	980	820

PHASE I SUMP REMOVAL ACTION PROGRAM - MASSACHUSETTS MILITARY RESERVATION

Parameter	Site: CS-8/CD-1 Matr: SOIL Dpth: 12 ISIS: 04TRX12X12X1XF Date: 28-FE8-92	CS-8/CD-1 SOIL 18 04TRX12X18X1XF 28-FEB-92	CS-8/CD-1 SOIL 24 04TRX12X24X1XF 28-FEB-92	CS-8/CD-1 SOIL 4 04TRX13XX4X1XF 04-MAR-92	CS-8/CD-1 SOIL 8 04TRX13XX8X1DF 04-MAR-92	CS-8/CD-1 SOIL 8 04TRX13XX8X1XF 04-MAR-92	CS-8/CD-1 SOIL 12 04TRX13X12X1XF 04-MAR-92	CS-8/CD-1 SOIL 18 04TRX13X18X1XF 04-MAR-92
PI meter reading (ppm)	5.2	1.9	1.9	0.0	0.0	0.0	0.0	0.0
VOCs (ug/kg)								
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	ND	ND	ND	ND	ND	ND	ND	ND
m/p-Xylene	ND	ND	ND	ND	ND	ND	ND	ND
SVOCs **(ug/kg)**	ND	ND	ND	ND	ND	ND	ND	ND
Pest/PCBs (ug/kg)								
Delta-BHC	150	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	1300	ND	ND	ND	ND	ND	ND	ND
Inorganics (mg/kg)								
Lead	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND	ND	ND
TPH (mg/kg)	83	120	40	170	330	320	290	410

PHASE I SUMP REMOVAL ACTION PROGRAM - MASSACHUSETTS MILITARY RESERVATION

Parameter	Site:	CS-8/CD-1	CS-8/CD-1	CS-8/CD-1	CS-8/CD-1	CS-8/CD-1	CS-8/CD-1
	Matr:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Dpth:	24	4	8	12	18	24
	ISIS:	04TRX13X24X1XF	04TRX14XX4X1XF	04TRX14XX8X1XF	04TRX14X12X1XF	04TRX14X18X1XF	04TRX14X24X1XF
	Date:	04-MAR-92	04-MAR-92	04-MAR-92	04-MAR-92	04-MAR-92	04-MAR-92
PI meter reading (ppm)		0.0	0.0	0.0	2.9	0.0	0.0
VOCs (ug/kg)							
Toluene		ND	ND	ND	ND	ND	ND
Ethylbenzene		ND	ND	ND	ND	ND	ND
o-Xylene		ND	ND	ND	ND	ND	ND
m/p-Xylene		ND	6.1	ND	ND	ND	ND
SVOCs (ug/kg)		ND	ND	ND	ND	ND	ND
Pest/PCBs (ug/kg)							
Delta-BHC		ND	ND	ND	ND	ND	ND
Heptachlor epoxide		ND	ND	ND	ND	ND	ND
Inorganics (mg/kg)							
Lead		ND	ND	ND	ND	ND	ND
Copper		ND	ND	ND	ND	ND	ND
Zinc		ND	ND	ND	ND	ND	ND
Arsenic		ND	ND	ND	ND	ND	ND
Chromium		ND	ND	ND	ND	ND	ND
TPH (mg/kg)		410	180	160	120	210	410

APPENDIX C
UNDERGROUND STORAGE TANK REMOVAL DETAILS

March 5, 1996
Reference #9509874

SIMMONS
Environmental Services, Inc.

Colonel Louis Volpe
State Quartermaster
The Commonwealth of Massachusetts
Office of the State Quartermaster
Camp Curtis Guild, Reading, Massachusetts 01867-1999

Re: UST Removal Report
5000 Gallon Gasoline Tank
Office and Maintenance #22, Building #9002
Outer Road
Camp Edwards, Massachusetts 02542

Dear Colonel Volpe:

On February 13, 1996, Simmons Environmental Services, Inc. (**SIMMONS**) observed the removal of a 6000 gallon gasoline underground storage tank (UST) at the area designated as Office and Maintenance #22, Building #9002, Outer Road in Camp Edwards, Massachusetts. (See Site Plan).

The UST removal, cleaning and disposal was conducted by personnel from ZECCO, INC. of Northboro, Massachusetts. Philip Motta, Assistant Chief Fire Inspector for Otis Air Force Base was onsite for inspection of the UST and its removal. Stephan H. Landry, Hydrogeologist of **SIMMONS**, was onsite to observe the subsurface conditions, field screen the UST excavation soils for headspace volatiles, and collect UST excavation floor soil samples for laboratory analyses. Mr. John Callan was onsite as the site Project Manager.

The UST was situated underneath a 10" thick concrete pad and connected to an adjacent fuel pump. The UST area was approximately 50' east of the OMS #22 building. There was no surficial staining observed on the concrete pavement or around the UST fill pipe. According to the ZECCO vacuum truck operator, prior to excavation, approximately 1600 gallons of gasoline product was removed from the UST. The top of the UST was approximately 2.5' below grade. The UST was measured to be 8'1" in diameter and 13'8" in length. Upon removal, the UST was noted to be in excellent condition with no evidence of holes, pitting or staining. According to Mr. Callan, the UST was approximately 6-7 years old.

375 Elm Street
Salisbury, MA 01952
Telephone 508-463-6669
Fax 508-463-6679

There was no overt evidence of soil staining or odors from the UST excavation soils. As specified by Mr. Callan, representative soils from the excavation north end and south end bottoms and east sidewall were collected and field screened in accordance with the Massachusetts Department of Environmental Protection (MDEP) jar headspace methodology using a pre-calibrated HNu Photoionization Detector (PID) model 101 (10.2 eV). The results of the headspace field screening is shown in the table below expressed in parts per million (ppm). Each of the soil samples showed less than 10 ppm headspace, the samples were then transported under a Chain of Custody to a state certified laboratory for analysis of volatile organic compounds (VOCs) by EPA Method 8240 with Ethylene Dibromide, Semi-volatile organic compounds (SVOCs) by EPA Method 8270, total petroleum compounds (TPHs) by EPA Method 8100 modified and total lead. The results of these analyses are also shown in the table below.

LOCATION	PID (ppm)	TPHs (mg/Kg)	VOCs (ug/Kg)	SVOCs (ug/Kg)	Total Lead (mg/Kg)
North End Bottom	0	ND	ND	ND	5.2
South End Bottom	2.2	ND	ND	ND	3.9
East Wall	0	ND	ND	ND	<2.6

ND = No Detectable concentrations above laboratory method's detection limit

There were no exceedances of the MDEP's Reportable Concentrations as listed in 310 CMR 40.0000, the Massachusetts Contingency Plan (MCP), for the compounds analyzed. Therefore, no further actions are warranted. The analytical data and site diagram of the work to date are enclosed. If there are any questions, please call either of the undersigned at 508-463-6669.

Very truly yours,

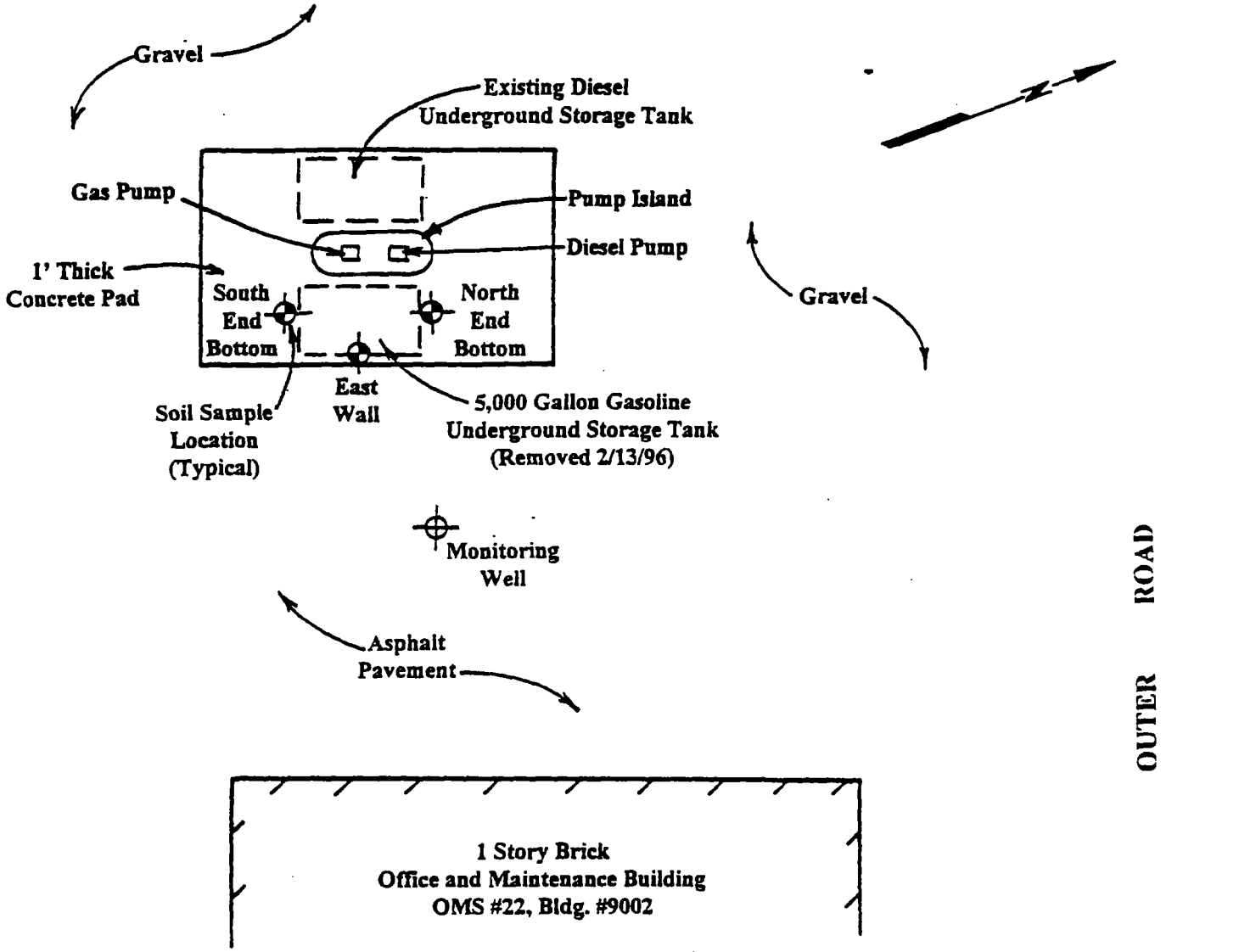
Robyn Chasson

for Stephan H. Landry
Hydrogeologist

William A. Simmons

William A. Simmons, LSP
Principal

WAS:rac



5,000 GALLON GASOLINE UNDERGROUND STORAGE TANK CLOSURE & SOIL SAMPLING PLAN

FOR PROPERTY AT:

OMS #22, BLDG. #9002
OUTER ROAD
CAMP EDWARDS, MA

PREPARED BY:

SIMMONS ENVIRONMENTAL SERVICES, INC.
375 ELM STREET
SALISBURY, MA 01952
(508) 463-6669

0' 10' 20' 40'

SCALE: 1"=20' PROJECT #: 9509874 DATE: FEBRUARY 13, 1996 DRAFTED: SHL/AK

AMRO Environmental Laboratories Corporation

111 Herrick Street, Merrimack, NH 03054
TEL: (603) 424-2022 · FAX: (603) 429-8496

February 23, 1996

Mr. William Simmons
Simmons Environmental Services, Inc.
375 Elm St. Crossroads Plaza
Salisbury, MA 01952

RE Your project: 9509874 Mass Guard

Dear William:

Enclosed please find the results for the above-referenced project, received on February 14, 1996. AMRO operates a Quality Control Program which meets or exceeds EPA and state requirements. A copy of the appropriate State Certificate is attached. No quality control deviations were noted during the analyses associated with this project. This project was assigned AMRO Project Number 12257. If you have any questions regarding this project in the future, please refer to this number.

Please be advised that any unused sample volume and sample extracts will be stored for a period of thirty (30) days from this report date. After this time, AMRO will properly dispose of the remaining sample. If you require further analysis, or need the samples held for a longer period, please contact us immediately.

This letter is an integral part of your data report.

Please do not hesitate to call if you have any questions.

Sincerely,

Maria N. Borduz

Maria N. Borduz, Ch.E.
President

Encl.

AMRO

AMRO Environmental Laboratory Report

Client:
Simmons Environmental Services, Inc.
375 Elm St.
Crossroads Plaza
Salisbury, MA 01952
Attn: Mr. William Simmons

Client Designation:
9509874 Mass Guard

Samples Qty/Type: 3/Solid

AMRO Designation: 12257
Date Sampled: 02/13/96
Date Rec'vd: 02/14/96
Date Complete: 02/22/96
COC #: 14071

Sample Identity	AMRO Identity	Test Parameter	Results	Units	Date of Analysis	Run by	EPA Method
SK UST, East Wall	12257-01	Total Solids	96.5	%	02/15/96	RR	2540G
		Digestion			02/16/96	TM	3050
		Lead, Total	5.2	mg/Kg	02/22/96	TM	6010
SK UST, South End Bottom	12257-02	Total Solids	97.1	%	02/15/96	RR	2540G
		Digestion			02/16/96	TM	3050
		Lead, Total	3.9	mg/Kg	02/22/96	TM	6010
SK UST, North End Bottom	12257-03	Total Solids	96.8	%	02/15/96	RR	2540G
		Digestion			02/16/96	TM	3050
		Lead, Total	<2.6	mg/Kg	02/22/96	TM	6010

Results are in dry weight.
All analyses performed in accordance with:
USEPA Methods of Chemical Analysis for Water & Waste.
Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992. and USEPA SW846 Manual, 3rd. ed.
The following standard abbreviations and conventions apply throughout all sections:
< = 'Less than' followed by the detection limit.
> = 'Greater than'

Certified by: Maria N. Borduz
Maria N. Borduz, Ch.E.

AMRO

LABORATORY REPORT

Petroleum Hydrocarbons by Gas Chromatography
EPA Method 8100 (Modified)

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, East Wall
AMRO I.D.: 12257-01
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/19/96 Date analyzed: 02/20/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit(mg/kg)
Gasoline	ND	51
Kerosene	ND	51
Mineral Spirits	ND	51
Fuel Oil #2/Diesel	ND	51
Fuel Oil #4	ND	51
Fuel Oil #6	ND	100
Motor Oil/Hydraulic Oil	ND	51

Gasoline results are provided for screening purposes only. The recommended procedure for gasoline analysis is a modified EPA 8015 or 8240 (purge and trap).
Solid Content = 96.5%. Results are in dry weight.
Comments:

ND = Not Detected at or above the reporting limit.

Analyzed By: JK

Approved by Lauren Nardone
for Nancy Stewart

AMRO

LABORATORY REPORT

Petroleum Hydrocarbons by Gas Chromatography
EPA Method 8100 (Modified)

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, South End Bottom
AMRO I.D.: 12257-02
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/19/96 Date analyzed: 02/20/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
Gasoline	ND	50
Kerosene	ND	50
Mineral Spirits	ND	50
Fuel Oil #2/Diesel	ND	50
Fuel Oil #4	ND	50
Fuel Oil #6	ND	99
Motor Oil/Hydraulic Oil	ND	50

Gasoline results are provided for screening purposes only. The recommended procedure for gasoline analysis is a modified EPA 8015 or 8240 (purge and trap).
Solid Content = 97.1%. Results are in dry weight.
Comments:

ND = Not Detected at or above the reporting limit.

Analyzed By: JK

Approved by Lauren Nardone
for Nancy Stewart

AMRO

LABORATORY REPORT

Petroleum Hydrocarbons by Gas Chromatography
EPA Method 8100 (Modified)

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, North End Bottom
AMRO I.D.: 12257-03
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/19/96 Date analyzed: 02/20/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
Gasoline	ND	50
Kerosene	ND	50
Mineral Spirits	ND	50
Fuel Oil #2/Diesel	ND	50
Fuel Oil #4	ND	50
Fuel Oil #6	ND	99
Motor Oil/Hydraulic Oil	ND	50

Gasoline results are provided for screening purposes only. The recommended procedure for gasoline analysis is a modified EPA 8015 or 8240 (purge and trap).
Solid Content = 96.8%. Results are in dry weight.
Comments:

ND = Not Detected at or above the reporting limit.

Analyzed By: JK

Approved by Lauren Nardone
for Nancy Stewart

AMRO

LABORATORY REPORT

EPA Method 8240B
Volatile Organic Compounds

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, East Wall
AMRO I.D.: 12257-01
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/15/96 Date analyzed: 02/16/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (ug/kg)	Reporting Limit(ug/kg)
Chloromethane	ND	67
Bromomethane	ND	67
Vinyl Chloride	ND	67
Chloroethane	ND	67
Methylene Chloride	ND	27
Acetone	ND	130
Carbon Disulfide	ND	27
1,1-Dichloroethene	ND	27
1,1-Dichloroethane	ND	27
1,2-Dichloroethene (trans)	ND	27
1,2-Dichloroethene (cis)	ND	27
Chloroform	ND	27
1,2-Dichloroethane	ND	27
2-Butanone (MEK)	ND	130
1,1,1-Trichloroethane	ND	27
Carbon Tetrachloride	ND	27
Vinyl Acetate	ND	130
Bromodichloromethane	ND	27
1,2-Dichloropropane	ND	27
cis-1,3-Dichloropropene	ND	27
Trichloroethene	ND	27
Dibromochloromethane	ND	27
1,1,2-Trichloroethane	ND	27
Benzene	ND	27
trans-1,3-Dichloropropene	ND	27
Bromoform	ND	27
4-Methyl-2-Pentanone (MIBK)	ND	130
2-Hexanone	ND	130
Tetrachloroethene	ND	27
1,1,2,2-Tetrachloroethane	ND	27
Toluene	ND	27
Chlorobenzene	ND	27
Ethylbenzene	ND	27
Styrene	ND	27
Xylene (total)	ND	27
Methyl-tert-butyl ether (MTBE)	ND	27
1,2-Dibromoethane (EDB)	ND	27

Solid Content = 96.5%. Results are in dry weight.
ND = Not Detected at or above the reporting limit

Analyzed By: SK Approved by Lauren Hardone
for Nancy Stewart

AMRO

LABORATORY REPORT

EPA Method 8240B
Volatile Organic Compounds

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, South End Bottom
AMRO I.D.: 12257-02
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/15/96 Date analyzed: 02/16/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (ug/kg)	Reporting Limit (ug/kg)
Chloromethane	ND	65
Bromomethane	ND	65
Vinyl Chloride	ND	65
Chloroethane	ND	65
Methylene Chloride	ND	26
Acetone	ND	130
Carbon Disulfide	ND	26
1,1-Dichloroethene	ND	26
1,1-Dichloroethane	ND	26
1,2-Dichloroethene (trans)	ND	26
1,2-Dichloroethene (cis)	ND	26
Chloroform	ND	26
1,2-Dichloroethane	ND	26
2-Butanone (MEK)	ND	130
1,1,1-Trichloroethane	ND	26
Carbon Tetrachloride	ND	26
Vinyl Acetate	ND	130
Bromodichloromethane	ND	26
1,2-Dichloropropane	ND	26
cis-1,3-Dichloropropene	ND	26
Trichloroethene	ND	26
Dibromochloromethane	ND	26
1,1,2-Trichloroethane	ND	26
Benzene	ND	26
trans-1,3-Dichloropropene	ND	26
Bromoform	ND	26
4-Methyl-2-Pentanone (MIBK)	ND	130
2-Hexanone	ND	130
Tetrachloroethene	ND	26
1,1,2,2-Tetrachloroethane	ND	26
Toluene	ND	26
Chlorobenzene	ND	26
Ethylbenzene	ND	26
Styrene	ND	26
Xylene (total)	ND	26
Methyl-tert-butyl ether (MTBE)	ND	26
1,2-Dibromoethane (EDB)	ND	26

Solid Content = 97.1%. Results are in dry weight.
ND = Not Detected at or above the reporting limit

Analyzed By: SK

Approved by Lauren Mardale
for Nancy Stewart

AMRO

LABORATORY REPORT

EPA Method 8240B
Volatile Organic Compounds

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, North End Bottom
AMRO I.D.: 12257-03
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/15/96 Date analyzed: 02/16/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (ug/kg)	Reporting Limit(ug/kg)
Chloromethane	ND	66
Bromomethane	ND	66
Vinyl Chloride	ND	66
Chloroethane	ND	66
Methylene Chloride	ND	26
Acetone	ND	130
Carbon Disulfide	ND	26
1,1-Dichloroethene	ND	26
1,1-Dichloroethane	ND	26
1,2-Dichloroethene (trans)	ND	26
1,2-Dichloroethene (cis)	ND	26
Chloroform	ND	26
1,2-Dichloroethane	ND	26
2-Butanone (MEK)	ND	130
1,1,1-Trichloroethane	ND	26
Carbon Tetrachloride	ND	26
Vinyl Acetate	ND	130
Bromodichloromethane	ND	26
1,2-Dichloropropane	ND	26
cis-1,3-Dichloropropene	ND	26
Trichloroethene	ND	26
Dibromochloromethane	ND	26
1,1,2-Trichloroethane	ND	26
Benzene	ND	26
trans-1,3-Dichloropropene	ND	26
Bromoform	ND	26
4-Methyl-2-Pentanone (MIBK)	ND	130
2-Hexanone	ND	130
Tetrachloroethene	ND	26
1,1,2,2-Tetrachloroethane	ND	26
Toluene	ND	26
Chlorobenzene	ND	26
Ethylbenzene	ND	26
Styrene	ND	26
Xylene (total)	ND	26
Methyl-tert-butyl ether (MTBE)	ND	26
1,2-Dibromoethane (EDB)	ND	26

Solid Content = 96.8%. Results are in dry weight.
ND = Not Detected at or above the reporting limit

Analyzed By: SK Approved by Lauren Nardone for Nancy Stewart

AMRO

QC REPORT FOR AMRO PROJECT #12257

VOLATILE ORGANICS

1,1-Dichloroethene	99%
Trichloroethene	97%
Benzene	102%
Toluene	99%
Chlorobenzene	97%

ANALYST: SK

LABORATORY REPORT

EPA Method 8270
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, East Wall
AMRO I.D.: 12257-01
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/15/96 Date analyzed: 02/15/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
1,3-Dichlorobenzene	ND	0.26
1,4-Dichlorobenzene	ND	0.26
Bis(2-Chloroethyl)Ether	ND	0.26
Hexachloroethane	ND	0.26
1,2-Dichlorobenzene	ND	0.26
Bis(2-Chloroisopropyl)Ether	ND	0.26
N-Nitroso-Di-n-Propylamine	ND	0.26
Nitrobenzene	ND	0.26
Hexachlorobutadiene	ND	0.26
1,2,4-Trichlorobenzene	ND	0.26
Isophorone	ND	0.26
Bis(2-Chloroethoxy)Methane	ND	0.26
Hexachlorocyclopentadiene	ND	0.26
2-Chloronaphthalene	ND	0.26
Dimethyl Phthalate	ND	0.26
2,6-Dinitrotoluene	ND	0.26
4-Chlorophenyl-Phenylether	ND	0.26
2,4-Dinitrotoluene	ND	0.26
Diethylphthalate	ND	0.26
N-Nitrosodiphenylamine	ND	0.26
4-Bromophenylphenyl Ether	ND	0.26
Hexachlorobenzene	ND	0.26
Di-n-Butylphthalate	ND	0.26
Butylbenzylphthalate	ND	0.26
Bis(2-Ethylhexyl)Phthalate	ND	0.26
3,3'-Dichlorobenzidine	ND	0.26
Di-n-Octyl Phthalate	ND	0.26
N-Nitrosodimethylamine	ND	0.26
Pyrene	ND	0.26
Benzo(a)Anthracene	ND	0.26
Chrysene	ND	0.26
Benzo(b)Fluoranthene	ND	0.26
Benzo(k)Fluoranthene	ND	0.26
Benzo(a)Pyrene	ND	0.26

Continued next page...

LABORATORY REPORT

EPA Method 8270/Solid Sample
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: SK UST, East Wall
AMRO I.D.: 12257-01

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
Indeno(1,2,3-c,d)Pyrene	ND	0.26
Dibenzo(a,h)Anthracene	ND	0.26
Benzo(g,h,i)Perylene	ND	0.26
Naphthalene	ND	0.26
Acenaphthylene	ND	0.26
Acenaphthene	ND	0.26
Fluorene	ND	0.26
Phenanthrene	ND	0.26
Anthracene	ND	0.26
Fluoranthene	ND	0.26
2-Methylnaphthalene	ND	0.26
Dibenzofuran	ND	0.64

Solid Content = 96.5%. Results are in dry weight.
ND = Not Detected at or above the reporting limit.

Analyzed By: NM

Approved by Lauren Nardone
for Nancy Stewart

LABORATORY REPORT

EPA Method 8270
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, South End Bottom
AMRO I.D.: 12257-02
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/15/96 Date analyzed: 02/15/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
1,3-Dichlorobenzene	ND	0.25
1,4-Dichlorobenzene	ND	0.25
Bis(2-Chloroethyl)Ether	ND	0.25
Hexachloroethane	ND	0.25
1,2-Dichlorobenzene	ND	0.25
Bis(2-Chloroisopropyl)Ether	ND	0.25
N-Nitroso-Di-n-Propylamine	ND	0.25
Nitrobenzene	ND	0.25
Hexachlorobutadiene	ND	0.25
1,2,4-Trichlorobenzene	ND	0.25
Isophorone	ND	0.25
Bis(2-Chloroethoxy)Methane	ND	0.25
Hexachlorocyclopentadiene	ND	0.25
2-Chloronaphthalene	ND	0.25
Dimethyl Phthalate	ND	0.25
2,6-Dinitrotoluene	ND	0.25
4-Chlorophenyl-Phenylether	ND	0.25
2,4-Dinitrotoluene	ND	0.25
Diethylphthalate	ND	0.25
N-Nitrosodiphenylamine	ND	0.25
4-Bromophenylphenyl Ether	ND	0.25
Hexachlorobenzene	ND	0.25
Di-n-Butylphthalate	ND	0.25
Butylbenzylphthalate	ND	0.25
Bis(2-Ethylhexyl)Phthalate	ND	0.25
3,3'-Dichlorobenzidine	ND	0.25
Di-n-Octyl Phthalate	ND	0.25
N-Nitrosodimethylamine	ND	0.25
Pyrene	ND	0.25
Benzo(a)Anthracene	ND	0.25
Chrysene	ND	0.25
Benzo(b)Fluoranthene	ND	0.25
Benzo(k)Fluoranthene	ND	0.25
Benzo(a)Pyrene	ND	0.25

Continued next page...

AMRO

LABORATORY REPORT

EPA Method 8270/Solid Sample
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: SK UST, South End Bottom
AMRO I.D.: 12257-02

Test Parameter	Results (mg/kg)	Reporting Limit (mg/kg)
Indeno(1,2,3-c,d)Pyrene	ND	0.25
Dibenzo(a,h)Anthracene	ND	0.25
Benzo(g,h,i)Perylene	ND	0.25
Naphthalene	ND	0.25
Acenaphthylene	ND	0.25
Acenaphthene	ND	0.25
Fluorene	ND	0.25
Phenanthrene	ND	0.25
Anthracene	ND	0.25
Fluoranthene	ND	0.25
2-Methylnaphthalene	ND	0.25
Dibenzofuran	ND	0.63

Solid Content = 97.1%. Results are in dry weight.
ND = Not Detected at or above the reporting limit.

Analyzed By: NM

Approved by Lauren Nardone
for Nancy Stewart

LABORATORY REPORT

EPA Method 8270
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: 9509874 Mass Guard
SK UST, North End Bottom
AMRO I.D.: 12257-03
Date sampled: 02/13/96 Date received: 02/14/96
Date prepared: 02/19/96 Date analyzed: 02/19/96
Sample Qty/Type: 1/Solid

Test Parameter	Results (mg/kg)	Reporting Limit(mg/kg)
1,3-Dichlorobenzene	ND	0.25
1,4-Dichlorobenzene	ND	0.25
Bis(2-Chloroethyl)Ether	ND	0.25
Hexachloroethane	ND	0.25
1,2-Dichlorobenzene	ND	0.25
Bis(2-Chloroisopropyl)Ether	ND	0.25
N-Nitroso-Di-n-Propylamine	ND	0.25
Nitrobenzene	ND	0.25
Hexachlorobutadiene	ND	0.25
1,2,4-Trichlorobenzene	ND	0.25
Isophorone	ND	0.25
Bis(2-Chloroethoxy)Methane	ND	0.25
Hexachlorocyclopentadiene	ND	0.25
2-Chloronaphthalene	ND	0.25
Dimethyl Phthalate	ND	0.25
2,6-Dinitrotoluene	ND	0.25
4-Chlorophenyl-Phenylether	ND	0.25
2,4-Dinitrotoluene	ND	0.25
Diethylphthalate	ND	0.25
N-Nitrosodiphenylamine	ND	0.25
4-Bromophenylphenyl Ether	ND	0.25
Hexachlorobenzene	ND	0.25
Di-n-Butylphthalate	ND	0.25
Butylbenzylphthalate	ND	0.25
Bis(2-Ethylhexyl)Phthalate	ND	0.25
3,3'-Dichlorobenzidine	ND	0.25
Di-n-Octyl Phthalate	ND	0.25
N-Nitrosodimethylamine	ND	0.25
Pyrene	ND	0.25
Benzo(a)Anthracene	ND	0.25
Chrysene	ND	0.25
Benzo(b)Fluoranthene	ND	0.25
Benzo(k)Fluoranthene	ND	0.25
Benzo(a)Pyrene	ND	0.25

Continued next page...

LABORATORY REPORT

EPA Method 8270/Solid Sample
Semivolatile Organic Compounds
Base/Neutral Extractables

Client: Simmons Environmental Services, Inc.
Client I.D.: SK UST, North End Bottom
AMRO I.D.: 12257-03

Test Parameter	Results (mg/kg)	Reporting Limit(mg/kg)
Indeno(1,2,3-c,d)Pyrene	ND	0.25
Dibenzo(a,h)Anthracene	ND	0.25
Benzo(g,h,i)Perylene	ND	0.25
Naphthalene	ND	0.25
Acenaphthylene	ND	0.25
Acenaphthene	ND	0.25
Fluorene	ND	0.25
Phenanthrene	ND	0.25
Anthracene	ND	0.25
Fluoranthene	ND	0.25
2-Methylnaphthalene	ND	0.25
Dibenzofuran	ND	0.64

Solid Content = 96.8%. Results are in dry weight.
ND = Not Detected at or above the reporting limit.

Analyzed By: NM

Approved by Lauren Nardone
for Nancy Stewart

AMRO Environmental Laboratories Corporation
111 Herrick Street
Merrimack, N.H. 03054
Office: 603-424-2022 Fax: 603-429-8496

14071

CHAIN OF CUSTODY RECORD

Proj. No.	Project Name	Project State
9509874	MASS GUARD	MA

Samplers (Signature): Stephen M Kennedy

PAGE 1 OF 1

Sta. No.	Date	Time	Comp	Grab	Station Location	Type Size, & No. of Containers	8240 w/ETHYL ENE DIBROMIDE	8100 MOD (TPH)	8270 (BN ONLY)	TOTAL LEAD ONLY	Remarks
	2/13/96	1:00		✓	SK UST, EAST WALL	3 SOIL 7 ABS	5	✓	✓	✓	✓	
	↓	↓		✓	SK UST, SOUTH END BOTTOM	↓	5	✓	✓	✓	✓	
	↓	↓		✓	SK UST, NORTH END BOTTOM	↓	5	✓	✓	✓	✓	
							1		1			

Please print clearly, legibly and completely. Samples cannot be logged in and the turnaround time clock will not start until any ambiguities are resolved.

PRIORITY TURNAROUND TIME AUTHORIZATION

Before submitting samples for expedited T.A.T., you must have requested in advance and received a coded **T.A.T. AUTHORIZATION NUMBER.**

AUTHORIZATION NO. _____ **T.A.T. authorized by:** _____

Relinquished by (Signature)	Date Time	Received by (Signature)
Stephen M Kennedy	2/14/96 10:40	
Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by (Signature)	Date Time	Received by (Signature)
Relinquished by (Signature)	Date Time 2.14.96 3:30	Received by (Signature)

☐ Fax to (phone) 508-463-6679

Results needed 2/29/96 STD

PO#

AMRO Project No. 12257

Seal Intact? Yes No N/A

Send Results to: William Simmons

SIMMONS ENVIRONMENTAL SERVICES, INC.
375 Elm Street
Salisbury, MA 01952

Remarks

The Commonwealth of Massachusetts

Department of Environmental Protection
Division of Environmental Analysis

Certifies

Laboratory ID #: M-NH012

Amro Environmental Lab
11 Herrick St.
Merrimack, NH 03054

for the Chemical Analysis of Potable and Non-Potable Water

pursuant to 310 CMR 42.00

Laboratory Director: Nancy Stewart

Expiration Date: 06/30/96

This certificate supercedes all previous Massachusetts certificates issued to this laboratory. The laboratory is regulated by and shall be responsible for being in compliance with Massachusetts regulations at 310 CMR 42.00.

This certificate is valid only when accompanied by the latest dated Certified Parameter List as issued by the Massachusetts D.E.P.

Certification is no guarantee of the validity of the data. This certification is subject to unannounced laboratory inspections.

Director, Division of Environmental Analysis

01/01/95
Issued

HLA

Soil Analysis

SQM #34-98
Bldg. 5218 & OMS #22
Camp Edwards
Bourne, Massachusetts

Prepared for

Office of the State Quartermaster
50 Maple Street
Milford, MA 01757

By

TMC Services, Inc.
P O Box 481
Bellingham, MA 02019

March 6, 1998

TMC Services, Inc.

Post Office Box 451
Bellingham, MA 02019

TEL. (508) 966-3737
FAX (508) 966-4991

March 6, 1998

Mr. David Tessicini
The Commonwealth of Massachusetts
Military Division
Office of the State Quartermaster
50 Maple Street
Milford, MA 01757

RE: SQM# 45-98
Removal of Two (2) Underground Storage Tanks &
Soil Analysis
Bldg. 5218 & OMS# 22 Camp Edwards

Dear Mr Tessicini:

The following information and enclosed documents have been prepared to satisfy the Underground Storage Tank (UST) Closure Assessment Report requirement listed in the project specifications.

SCOPE OF WORK

This project entailed the removal of USTs from the following locations:

Building# 5218
Turpentine Road
Camp Edwards
Tank Size: 500 gallons
Contents: 500 gallons No. 2 Fuel Oil

OMS 22
South Outer Road
Camp Edwards
Tank Size: 12,500 gallons
Contents: 200 gallons Diesel Fuel

TMC Services, Inc.

NARRATIVE

Building# 5218, Turpentine Road

Tank removal was initiated on February 12, 1998. The tank was discovered approximately two feet below grade at the rear of the building on the south west corner. Tank contents were emptied into drums pending removal for disposal. Dry ice was placed in the emptied tank and allowed to sit. Under observation of the Fire Marshal from Otis Air National Guard, the tank was then extracted from the ground using a Backhoe Loader. Grab samples were then taken from all four walls of the tank grave and one from its base. A head space was performed on each of these sample points using a Thermal Environmental Photo Ionization Detector (PID) Model 580E [results are listed in Sampling Data Sheet]. Two additional samples were collected from each of these points. Fifteen grams of soil was collected for VPH in a 40mL VOC vial with 15 grams of methanol. The second sample was placed in a wide mouth glass jar with Teflon lined screw cap for analysis of EPH [see laboratory data]. Samples were collected using a stainless steel spoon from a point approximately 12" from the surface of the excavation. The sample spoon was cleaned between sample points.

OMS 22, South Outer Road

The tank was removed on February 12, 1998. The tank was located on the south side on the building. Two observation wells were located at the ends of the tank. Both wells were opened and examined. The wells did not contain ground water. The contents of the tank was emptied into drums. Dry ice was then added to the tank. The concrete apron above the tank was broken up and removed along with the fuel dispensing unit. The tank was then exposed using a track excavator. The emptied tank was then removed from the excavation under observation of the Fire Marshal from Otis Air National Guard. Grab samples were then taken from all four walls of the tank grave and one from its base. A head space was performed on each of these sample points using a Thermal Environmental Photo Ionization Detector (PID) Model 580E [results are listed in Sampling Data Sheet]. Two additional samples were collected from each of these points. Fifteen grams of soil was collected for VPH in a 40mL VOC vial with 15 grams of methanol. The second sample was placed in

TMC Services, Inc.

a wide mouth glass jar with Teflon lined screw cap for analysis of EPH [see laboratory data]. Samples were collected using a stainless steel spoon from a point approximately 12" from the surface of the excavation. The sample spoon was cleaned between sample points.

The emptied and clean tanks were removed and disposed of in accordance with Massachusetts requirements at a State certified tank disposal yard [see tank disposal permit and cards]. The removed oil and diesel from the two tanks was transported to United Oil Recovery Inc. Meriden, Connecticut, on February 19, 1998 [see copies of Manifests]

SUMMARY AND CONCLUSIONS

Building# 5218, Turpentine Road
PID results from the base of the tank indicated residual impact of petroleum product. These results were not duplicated in the EPH/VPH analysis of the soils taken from the same point [Sample CE05]. There were no other readings of petroleum contaminants from this tank grave.

OMS 22, South Outer Road
There were no PID readings or indication of petroleum contamination during the removal of the tank at OMS #22. Petroleum contamination was not detected from samples taken from the tank grave at this site.

Should you have any further questions, please contact me at 508-966-3737.

Sincerely,

TMC Services, Inc.

Matthew Clark
President

d:\wpdocs\rac98\sqm1.wpd

SAMPLING DATA SHEET

Project Name: CAMP EDWARDS

Date: 2/12/93

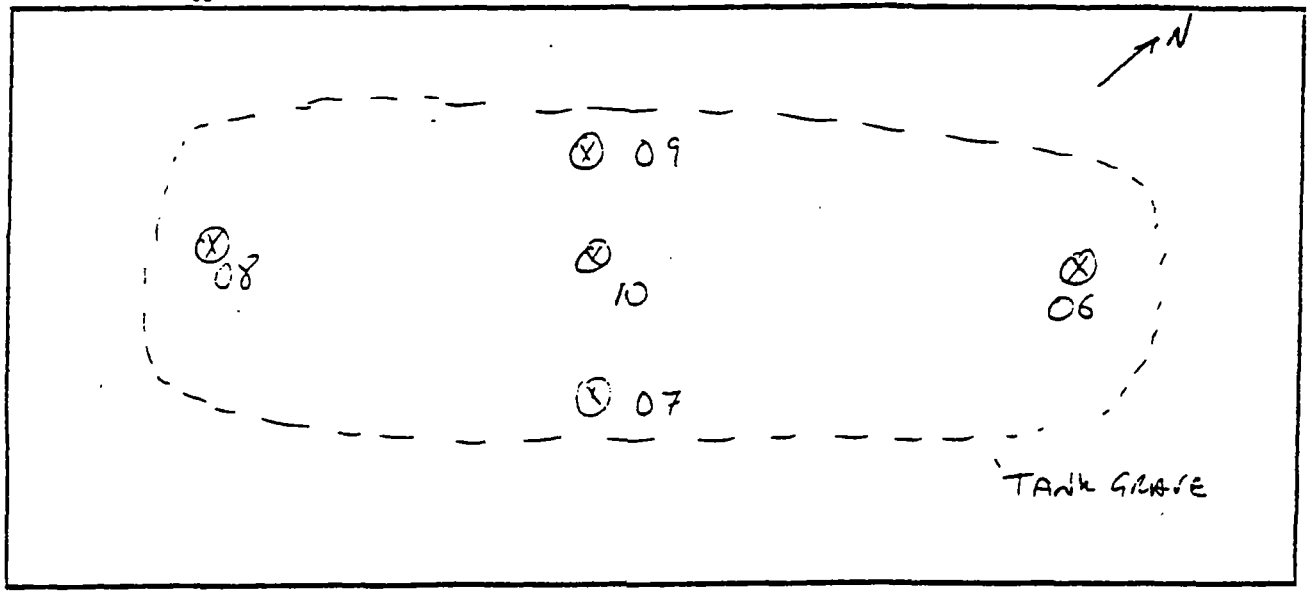
Site Name: OMS 22

Weather Conditions: CLOUDY / RAIN ~40's HIGH WINDS

Address: SOUTH OUTER ROAD
BOURNE MA

Sample No	Grab or Composite	PID Results	Comments
06	GRAB	0.0	8' BELOW GRADE
07	GRAB	0.0	8' BELOW GRADE
08	GRAB	0.0	9' BELOW GRADE
09	GRAB	0.0	8' BELOW GRADE
10	GRAB	0.0	13' BELOW GRADE * 1' BELOW TANK BASE

* GROUND WATER WAS DETECTED AT ~ 13' BELOW GRADE



Sketch stock pile area and sample points. Note any outstanding features or information.

Sampler's Certification: I hear by certify that the above information is true and accurate.

Name	Initial	Company	Date
RANDY CHIARIELLO		TMC	2-12-93

smpdoc.rac

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

PROJECT NARRATIVE

CLIENT: TMC Services
CLIENT PROJECT ID: Camp Edwards
ESS PROJECT ID: 980408

Sample Receipt
One liquid and ten solid samples were received on February 13, 1998 for the analyses specified on the enclosed Chain of Custody Record.

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. These analyses with these noted observations are in conformance to the Quality Assurance Plan.

Volatile Organics Analysis
Surrogate recoveries were outside of the recommended ranges for samples 980408-02. -05. -07, -08 and -10 due to matrix interferences.

No other observations noted.

This signed Certificate of Analysis is our approved release of your analytical results. Beginning with this Project Narrative, the entire report has been paginated. The Chain of Custody is the final report page. This report should not be copied except in full without the approval of the laboratory.

End of project narrative.

Laurel Stoddard/Eric Baanante
Laboratory Manager/Operations Manager

2/26/98
Date

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

Client: TMC Services

Client Project ID: Camp Edwards

Client Sample ID: CE06

Date Sampled: 2/13/98

Date Analyzed: 2/23/98

ESS Project ID: 980408

ESS Sample ID: 980408-06

Date Extracted: 2/18/98

Dilution Factor: 1x

Analyst: JAR

EXTRACTABLE PETROLEUM HYDROCARBON (EPH)

Parameter	Results	MDL	Units
n-C_9-n-C_{18} Aliphatics	ND	29	mg/Kg
n-C_{19}-n-C_{36} Aliphatics	ND	29	mg/Kg
C_{10}-C_{22} Aromatics*	ND	29	mg/Kg

* Excludes Target PAHs

ND = Not Detected above Method Detection Limit (MDL)

SURROGATE RECOVERIES

Surrogate	% Recovery	Advisory Range
Chloro-octadecane (COD)	89	40 - 140%
Ortho-terphenyl (OTP)	97	40 - 140%

Results reported on a dry weight basis.

185 Frances Avenue, Cranston, RI 02910-9975 Tel.: (401) 461-7181 Fax: (401) 461-4486

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

Client: TMC Services
Client Project ID: Camp Edwards
Client Sample ID: CE06
Date Sampled: 2/12/98

ESS Project ID: 980408
ESS Sample ID: 980408-06
Date Analyzed: 2/19/1998
Analyst: skh

VPH RESULTS

Parameter	Results	MDL	Units
n-C_5-n-C_8 Aliphatics*	ND	0.8	mg/kg dry wgt.
n-C_9-n-C_{12} Aliphatics**	ND	0.8	mg/kg dry wgt.
n-C_9-n-C_{10} Aromatics	ND	0.8	mg/kg dry wgt.

* = Excludes Benzene, Toluene and MTBE.
** = Excludes Ethylbenzene, Xylenes (total), 1,2,4-Trimethylbenzene and Naphthalene.

Surrogate Recoveries

Surrogate	% Recovery	Advisory Range
FID 4-Bromofluorobenzene	101	80-120%
PID 4-Bromofluorobenzene	109	80-120%

TARGETED VPH ANALYTES

Analyte	Results	MDL	Units
Methyl-tert-butylether	ND	150	µg/kg dry wgt.
Benzene	ND	150	µg/kg dry wgt.
Toluene	ND	150	µg/kg dry wgt.
Ethylbenzene	ND	150	µg/kg dry wgt.
M &P Xylene	ND	150	µg/kg dry wgt.
O Xylene	ND	150	µg/kg dry wgt.
Naphthalene	ND	150	µg/kg dry wgt.
1,2,4-Trimethylbenzene	ND	150	µg/kg dry wgt.

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

Client: TMC Services

Client Project ID: Camp Edwards

Client Sample ID: CE07

Date Sampled: 2/13/98

Date Analyzed: 2/23/98

ESS Project ID: 980408

ESS Sample ID: 980408-07

Date Extracted: 2/18/98

Dilution Factor: 1x

Analyst: JAR

EXTRACTABLE PETROLEUM HYDROCARBON (EPH)

Parameter	Results	MDL	Units
n-C_9-n-C_{18} Aliphatics	ND	26	mg/Kg
n-C_{19}-n-C_{36} Aliphatics	ND	26	mg/Kg
C_{10}-C_{22} Aromatics*	ND	26	mg/Kg

* Excludes Target PAHs

ND = Not Detected above Method Detection Limit (MDL)

SURROGATE RECOVERIES

Surrogate	% Recovery	Advisory Range
Chloro-octadecane (COD)	84	40 - 140%
Ortho-terphenyl (OTP)	96	40 - 140%

Results reported on a dry weight basis.

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

Client: TMC Services
Client Project ID: Camp Edwards
Client Sample ID: CE07
Date Sampled: 2/12/98

ESS Project ID: 980408
ESS Sample ID: 980408-07
Date Analyzed: 2/19/1998
Analyst: skh

VPH RESULTS

Parameter	Results	MDL	Units
n-C_5-n-C_8 Aliphatics*	ND	0.9	mg/kg dry wgt.
n-C_9-n-C_{12} Aliphatics**	ND	0.9	mg/kg dry wgt.
n-C_9-n-C_{10} Aromatics	ND	0.9	mg/kg dry wgt.

* = Excludes Benzene, Toluene and MTBE.
** = Excludes Ethylbenzene, Xylenes (total), 1,2,4-Trimethylbenzene and Naphthalene.

Surrogate Recoveries

Surrogate	% Recovery	Advisory Range
FID 4-Bromofluorobenzene	103	80-120%
PID 4-Bromofluorobenzene	110	80-120%

TARGETED VPH ANALYTES

Analyte	Results	MDL	Units
Methyl-tert-butylether	ND	180	µg/kg dry wgt.
Benzene	ND	180	µg/kg dry wgt.
Toluene	ND	180	µg/kg dry wgt.
Ethylbenzene	ND	180	µg/kg dry wgt.
M &P Xylene	ND	180	µg/kg dry wgt.
O Xylene	ND	180	µg/kg dry wgt.
Naphthalene	ND	180	µg/kg dry wgt.
1,2,4-Trimethylbenzene	ND	180	µg/kg dry wgt.

185 Frances Avenue, Cranston, RI 02910-9975 Tel: (401) 461-7181 Fax: (401) 461-4486

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

Client: **TMC Services**

Client Project ID: **Camp Edwards**

Client Sample ID: **CE08**

Date Sampled: **2/13/98**

Date Analyzed: **2/23/98**

ESS Project ID: **980408**

ESS Sample ID: **980408-08**

Date Extracted: **2/18/98**

Dilution Factor: **1x**

Analyst: **JAR**

EXTRACTABLE PETROLEUM HYDROCARBON (EPH)

Parameter	Results	MDL	Units
n-C_9-n-C_{18} Aliphatics	ND	26	mg/Kg
n-C_{19}-n-C_{36} Aliphatics	ND	26	mg/Kg
C_{10}-C_{22} Aromatics*	ND	26	mg/Kg

* Excludes Target PAHs

ND = Not Detected above Method Detection Limit (MDL)

SURROGATE RECOVERIES

Surrogate	% Recovery	Advisory Range
Chloro-octadecane (COD)	78	40 - 140%
Ortho-terphenyl (OTP)	94	40 - 140%

Results reported on a dry weight basis.

[illegible] Tel: 401 461-7181 Fax: 401 [illegible]

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

Client: TMC Services
Client Project ID: Camp Edwards
Client Sample ID: CE08
Date Sampled: 2/12/98

ESS Project ID: 980408
ESS Sample ID: 980408-08
Date Analyzed: 2/19/1998
Analyst: skh

VPH RESULTS

Parameter	Result	MDL	Units
n-C_5-n-C_8 Aliphatics*	ND	0.5	mg/kg dry wgt.
n-C_9-n-C_{12} Aliphatics**	ND	0.5	mg/kg dry wgt.
n-C_9-n-C_{10} Aromatics	ND	0.5	mg/kg dry wgt.

* = Excludes Benzene, Toluene and MTBE.
** = Excludes Ethylbenzene, Xylenes (total), 1,2,4-Trimethylbenzene and Naphthalene.

Surrogate Recoveries

Surrogate	% Recovery	Advisory Range
FID 4-Bromofluorobenzene	102	80-120%
PID 4-Bromofluorobenzene	109	80-120%

TARGETED VPH ANALYTES

Analyte	Results	MDL	Units
Methyl-tert-butylether	ND	104	µg/kg dry wgt.
Benzene	ND	104	µg/kg dry wgt.
Toluene	ND	104	µg/kg dry wgt.
Ethylbenzene	ND	104	µg/kg dry wgt.
M &P Xylene	ND	104	µg/kg dry wgt.
O Xylene	ND	104	µg/kg dry wgt.
Naphthalene	ND	104	µg/kg dry wgt.
1,2,4-Trimethylbenzene	ND	104	µg/kg dry wgt.

[illegible] Tel: (401) 461-7181 Fax (401) 461-4486

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

Client: **TMC Services**

Client Project ID: **Camp Edwards**

Client Sample ID: **CE09**

Date Sampled: **2/13/98**

Date Analyzed: **2/23/98**

ESS Project ID: **980408**

ESS Sample ID: **980408-09**

Date Extracted: **2/18/98**

Dilution Factor: **1x**

Analyst: **JAR**

EXTRACTABLE PETROLEUM HYDROCARBON (EPH)

Parameter	Results	MDL	Units
n-C_6-n-C_{18} Aliphatics	ND	26	mg/Kg
n-C_{19}-n-C_{36} Aliphatics	ND	26	mg/Kg
C_{10}-C_{32} Aromatics*	ND	26	mg/Kg

* Excludes Target PAHs

ND = Not Detected above Method Detection Limit (MDL)

SURROGATE RECOVERIES

Surrogate	% Recovery	Advisory Range
Chloro-octadecane (COD)	87	40 - 140%
Ortho-terphenyl (OTP)	103	40 - 140%

Results reported on a dry weight basis.

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

Client: TMC Services
Client Project ID: Camp Edwards
Client Sample ID: CE09
Date Sampled: 2/12/98

ESS Project ID: 980408
ESS Sample ID: 980408-09
Date Analyzed: 2/20/1998
Analyst: skh

VPH RESULTS

Parameter	Results	MDL	Units
n-C_5-n-C_8 Aliphatics*	ND	0.6	mg/kg dry wgt.
n-C_9-n-C_{12} Aliphatics**	ND	0.6	mg/kg dry wgt.
n-C_9-n-C_{10} Aromatics	ND	0.6	mg/kg dry wgt.

* = Excludes Benzene, Toluene and MTBE.
** = Excludes Ethylbenzene, Xylenes (total), 1,2,4-Trimethylbenzene and Naphthalene.

Surrogate Recoveries

Surrogate	% Recovery	Advisory Range
FID 4-Bromofluorobenzene	102	80-120%
PID 4-Bromofluorobenzene	111	80-120%

TARGETED VPH ANALYTES

Analyte	Results	MDL	Units
Methyl-tert-butylether	ND	115	µg/kg dry wgt.
Benzene	ND	115	µg/kg dry wgt.
Toluene	ND	115	µg/kg dry wgt.
Ethylbenzene	ND	115	µg/kg dry wgt.
M &P Xylene	ND	115	µg/kg dry wgt.
O Xylene	ND	115	µg/kg dry wgt.
Naphthalene	ND	115	µg/kg dry wgt.
1,2,4-Trimethylbenzene	ND	115	µg/kg dry wgt.

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

Client: TMC Services

Client Project ID: Camp Edwards

Client Sample ID: CE10

Date Sampled: 2/13/98

Date Analyzed: 2/23/98

ESS Project ID: 980408

ESS Sample ID: 980408-10

Date Extracted: 2/18/98

Dilution Factor: 1x

Analyst: JAR

EXTRACTABLE PETROLEUM HYDROCARBON (EPH)

Parameter	Results	MDL	Units
n-C_8-n-C_{18} Aliphatics	ND	27	mg/Kg
n-C_{19}-n-C_{36} Aliphatics	ND	27	mg/Kg
C_{10}-C_{32} Aromatics*	ND	27	mg/Kg

* Excludes Target PAHs

ND = Not Detected above Method Detection Limit (MDL)

SURROGATE RECOVERIES

Surrogate	% Recovery	Advisory Range
Chloro-octadecane (COD)	85	40 - 140%
Ortho-terphenyl (OTP)	101	40 - 140%

Results reported on a dry weight basis.

ESS Laboratory

Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

Client: TMC Services
Client Project ID: Camp Edwards
Client Sample ID: CE10
Date Sampled: 2/12/98

ESS Project ID: 980408
ESS Sample ID: 980408-10
Date Analyzed: 2/20/1998
Analyst: skh

VPH RESULTS

Parameter	Results	MDL	Units
n-C_5-n-C_8 Aliphatics*	ND	0.6	mg/kg dry wgt.
n-C_9-n-C_{12} Aliphatics**	ND	0.6	mg/kg dry wgt.
n-C_9-n-C_{10} Aromatics	ND	0.6	mg/kg dry wgt.

* = Excludes Benzene, Toluene and MTBE.
** = Excludes Ethylbenzene, Xylenes (total), 1,2,4-Trimethylbenzene and Naphthalene.

Surrogate Recoveries

Surrogate	% Recovery	Advisory Range
FID 4-Bromofluorobenzene	103	80-120%
PID 4-Bromofluorobenzene	112	80-120%

TARGETED VPH ANALYTES

Analyte	Results	MDL	Units
Methyl-tert-butylether	ND	125	µg/kg dry wgt.
Benzene	ND	125	µg/kg dry wgt.
Toluene	ND	125	µg/kg dry wgt.
Ethylbenzene	ND	125	µg/kg dry wgt.
M &P Xylene	ND	125	µg/kg dry wgt.
O Xylene	ND	125	µg/kg dry wgt.
Naphthalene	ND	125	µg/kg dry wgt.
1,2,4-Trimethylbenzene	ND	125	µg/kg dry wgt.

ESS Laboratory

CHAIN OF CUSTODY

Page 1 of 1

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486

Turn Time: ✓ Standard (2 Weeks) Other _____

ESS-LAB PROJECT ID: 0408

Co. Name: TYNE SEALES | Project #: | Project Name: CAPE ANNA

Contact Person: ANDRÉ CHIARADIA | Address: P.O. Box 431

City: BELLINGHAM | State: MA | Zip: 02019 | Tel. 508 966-3737

Purchase Order # | Fax # 508 966-4861

ESS LAB Sample #	Date	Collection Time	COMP	GRAB	MATRIX	Sample Identification	Number of Containers	Type of Container	Analysis Required: III PN	Analysis Required: VPN
01	2/12/98	1330		X	S	CE01	2	G	X	X
02	2/13	1330		X	S	CE02	2	G		
03	2/13	1330		X	S	CE03	2	G		
04	2/13	1330		X	S	CE04	2	G		
→ 05	2/13	1330		X	S	CE05	2	G		
06	2/13	1330		X	S	CE06	2	G		
07	2/13	1330		X	S	CE07	2	G		
→ 08	2/13	1330		X	S	CE08	2	G		
09	2/13	1330		X	S	CE09	2	G		
10	2/13	1330		X	S	CE10	2	G		
11	2/13	1330				TRIP BLANK CE11	1	G		

Container Type: P-Poly G-Glass S-Sterile V-VOA

Matrix: DW-Drinking Water S-Solid GW-Ground Water WW-Wastewater

Seals Intact: ____Yes ____No

Cooler Temp: _____

Comments:

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	2/13 19:30	[signature]	2/15 1835				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time

9800185

Commonwealth of Massachusetts

Department of Fire Services – Board of Fire Prevention

APPLICATION and PERMIT

Fee: _____

for storage tank removal and transportation to approved tank disposal yard in accordance with the provisions of M.G.L. Chapter 148, Section 38A, 527 CMR 9.00, application is hereby made by:

Tank Owner

Tank Owner Name (please print) Commonwealth of Massachusetts, Office of The State Quartermaster X _____ (Signature if applying for permit)

Address 50 Maple St., Milford, MA 01757 (Street / City / State / Zip)

Removal Contractor

Company Name TMC SERVICES, INC. (Print)

Address PO BOX 481, BELLINGHAM, MA 02019 (Print)

Signature (if applying for permit) Andre Chiandi

☐ IFCI Certified Other _____

Contamination Assessment

Co. or Individual TMC SERVICES, INC. (Print)

Address PO BOX 481, BELLINGHAM, MA 02019 (Print)

Signature (if applying for permit) _____

☐ IFCI Certified ☐ LSP # _____ Other _____

Tank Information

Tank Location CAMP EDWARDS, OMS #22 - SOUTH OUTER ROAD (Street Address / City)

Tank Capacity (gallons) 12,500 Substance Last Stored DIESEL FUEL

Tank Dimensions (diameter x length) ESTIMATED (96" X 32')

Remarks: _____

Disposal Information

Firm transporting waste UNITED INDUSTRIAL SERVICES State Lic. # 349

Hazardous waste manifest# CTF0612982 E.P.A. # CTD021816889

Approved tank disposal yard BROCKTON IRON Tank yard # 00010

Type of inert gas DRY ICE/N2 Tank yard address 45 FREIGHT ST., BROCKTON, MA 02402

Approvals

City or Town OTIS ANG B FDID# 01936 Permit# OM522-1

Date of issue 12 FEB 98 Date of expiration 12 FEB 98

Dig safe approval number: start date 2/11/98 @ 8:00am #980603653 Dig Safe Toll Free Tel. Number - 800-322-4844

Signature / Title of Officer granting permit Paul Motta

After removal(s) send Form FP-290R signed by Local Fire Dept. to UST Regulatory Compliance Unit, One Ashburton Place, Room 1310, Boston, MA 02108-1618.

Commonwealth of Massachusetts
Department of Fire Services - Office of the State Fire Marshal

RECEIPT OF DISPOSAL OF UNDERGROUND STEEL STORAGE TANK

m FP 291

NAME AND ADDRESS OF APPROVED TANK YARD ~~(508) 586-4640~~
BRISCO BALING CORP
45 FREIGHT STREET
BROCKTON, MA 02402

APPROVED TANK YARD NO. 00010 Tank Yard Ledger 502 CMR 3.03 (4) Number: 9800185

I certify under penalty of law I have personally examined the underground steel storage tank delivered to this "approved tank yard" by firm, corporation or partnership TMC Service, INC and accepted same in conformance with Massachusetts Fire Prevention Regulation 502 CMR 3.00 Provisions for Approving Underground Steel Storage Tank dismantling yards. A valid permit was issued by LOCAL Head of Fire Department. FDID# 0 1 9 3 6 to transport this tank to this yard.

Name and official title of approved tank yard owner or owners authorized representative:

SIGNATURE ______ TITLE ______ 2/13/98 DATE SIGNED

This signed receipt of disposal must be returned to the local head of the fire department FDID# 0 1 9 3 6 pursuant to 502 CMR 3.

EACH TANK MUST HAVE A RECEIPT OF DISPOSAL

TANK DATA

Gallons 12,500

Previous Contents Diesel Fuel

Diameter ______ Length ______

Date Received ______

Serial # (if available) ______

Tank I.D. # (Form FP-290) ______

TANK REMOVED FROM

CAMP EDWARDS OHS #22 SOUTH OUTER RD.
~~50 Naples ST~~
(No. and Street)

~~[illegible] 01757~~
(City or Town)

[illegible] 98603653

Fire Department Permit # CW522-1

Owner/Operator to mail revised copy of Notification Form (FP290, or FP290R) to : UST Compliance, Office of the State Fire Marshal, P.O. Box 1025 State Road, Stow, MA 01775.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Hazardous Waste MANIFEST PROGRAM
79 Elm St., Hartford, CT 06106-5127

FOR STATE USE ONLY

Please type (or print) *(Form designed for use on elite (12-pitch) typewriter.)*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of 1	Information in the shaded areas required by Federal law but not required by State law

GENERATOR

3. Generator's Name and Mailing Address

4. Generator's Phone ( )

A. State Manifest Document Number: CT F0650917

B. G.S.I.'s (Gen. Site Address)

C. G.S.I.'s (Trans. Lic. Plate #) CT 106

D. Trans. Phone ( )

E. S.T.1. (Trans. Lic. Plate #)

F. Trans. Phone ( )

G. State Facility's ID (Not Required)

H. Facility's Phone

5. Transporter 1 Company Name	6. US EPA ID Number
7. Transporter 2 Company Name	8. US EPA ID Number
9. Designated Facility Name and Site Address	10. US EPA ID Number

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	Waste No.
a.	001	CY	00550		EPA STATE
b.					EPA STATE
c.					EPA STATE
d.					EPA STATE

J. Additional Descriptions for Materials Listed Above	K. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

Point of Departure:

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations, and all applicable State laws and regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the pre and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Ye
		10	21	9

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Ye
Kenneth M. Bonito	Kenneth M. Bonito	10	21	9

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Ye

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Ye

IN THE EVENT OF A SPILL CONTACT THE NATIONAL RESPONSE CENTER, U.S. COAST GUARD 1-800-424-8802 ... FOR SPILLS WITHIN CONNECTICUT, CONTACT CT DEP - OIL AND CHEMICAL SPILL RESPONSE AT (203) 566-3338

APPENDIX D
DRAINAGE STUCTURE 04CDXX1 CLOSURE REPORT

CLOSURE REPORT

1. INTRODUCTION

1.1 DRAINAGE STRUCTURE REMOVAL PROGRAM

Massachusetts Military Reservation (MMR) is listed on the U.S. Environmental Protection Agency (USEPA) National Priority List. Remedial studies and activities are currently being conducted at MMR in accordance with guidelines and procedures of the USEPA Superfund program and the National Contingency Plan (NCP). Two types of action can be initiated under the NCP: remedial actions and removal actions. Remedial actions are long-term, permanent remediation of hazardous waste sites. Removal actions are short-term actions to abate or eliminate the release of contamination. The drainage structure removal program is a removal action program.

The National Guard Bureau (NGB) evaluated the drainage structures in a separate basewide program because of the similarity in operations and contaminants. The drainage structure removal program is based on the Phase I Sump Investigation Program conducted by ABB Environmental Services Inc. (ABB) and the Phase II Sump Investigation Program conducted by Metcalf and Eddy for the NGB. ABB characterized approximately 100 drainage structures. This characterization included sampling to identify potential contaminant sources. Also during this phase an additional 161 drainage structures were identified. Fifteen of these structures were characterized by Metcalf and Eddy as a high priority.

- A total of 185 drainage structures are included in the program. One hundred sixty-five of these structures are funded for removal. Currently, Jacobs Engineering Group is under contract through the Air Force Center for Environmental Excellence for the following work under the drainage structure removal program. The scope of work includes: The removal or abandonment in place of approximately 165 existing drainage structures on the Massachusetts Military Reservation and the associated liquid and sediment contents.
- Demolition of 12 existing vehicle maintenance slabs and foundations.
- Testing soil, liquid, sludge and sediment for contamination.
- Stockpiling and treatment or disposal of excavated drainage structure debris and surrounding soil.
- Backfilling and restoring excavations as specified.
- Preparing closure reports.

The work Jacobs is performing on the drainage structure removal program is governed by the "Final Drainage Structure Removal Program Specifications", July 1995, prepared for Massachusetts Military Reservation by Metcalf and Eddy; and the approved Jacobs' Plans (Drainage Structure Removal Program Volume I - Quality Project Plan and Volume II - Remedial Action Work Plan, January 1996, prepared for Massachusetts Military Reservation). These documents detail the procedures utilized by Jacobs during the removal of drainage structures.

1.2 CLEAN-UP LEVELS

The clean-up levels for the drainage structure removal program (DSRP) are determined by the MMR specific soil target clean-up levels (STCLs) as developed by HAZWRAP and presented in their letter, "Soil Target Clean Up Levels," dated January 30, 1996. The STCLs are risk based standards. The depth utilized for the DSRP is the 2 to 15 foot depth. Additionally, the STCLs are divided into several sub-categories: inside the flightline, outside the flightline, and clean fill. The inside and outside the flightline STCLs are based upon future use as well as risk. These standards apply to the bottom, inlet, and outlet samples and are used to determine that the drainage structure removal is a clean closure.

The clean fill STCLs apply to the paylimit sample. This data determines if the paylimit can be used for clean fill or requires treatment. The soil will be treated in the OABF if any of the contaminants tested are above the STCLs for clean fill. Additionally, if the soil fails the "twenty times" rule as defined in specification 01410, a paylimit sample will be analyzed for TCLP. If the soil passes the TCLP, it will be treated in the OABF. Any soil failing TCLP limits will be disposed off-site at a RCRA-regulated facility.

1.3 DRAINAGE STRUCTURE DESCRIPTION AND LOCATION

Drainage structure 04CDXX1 was located outside the flightline to the west of Building OMS-22, which is located in the Army National Guard Motor Pool area off of South Truck Rd. The drainage structure was a Cesspool (See Figure 1). It was not visible at the ground surface and had a depth of 10 feet. The survey coordinates are 237,242.3 North and 862,799.2 East.

The drainage structure had no cover. The structure walls were constructed of concrete barrel block with an open dirt bottom. The walls had collapsed. An 4-inch ceramic inlet pipe was observed with this structure. There was no outlet pipe present.

1.4 PREVIOUS INVESTIGATION HISTORY

1.4.1 BUILDING OMS-22 (Cesspool)

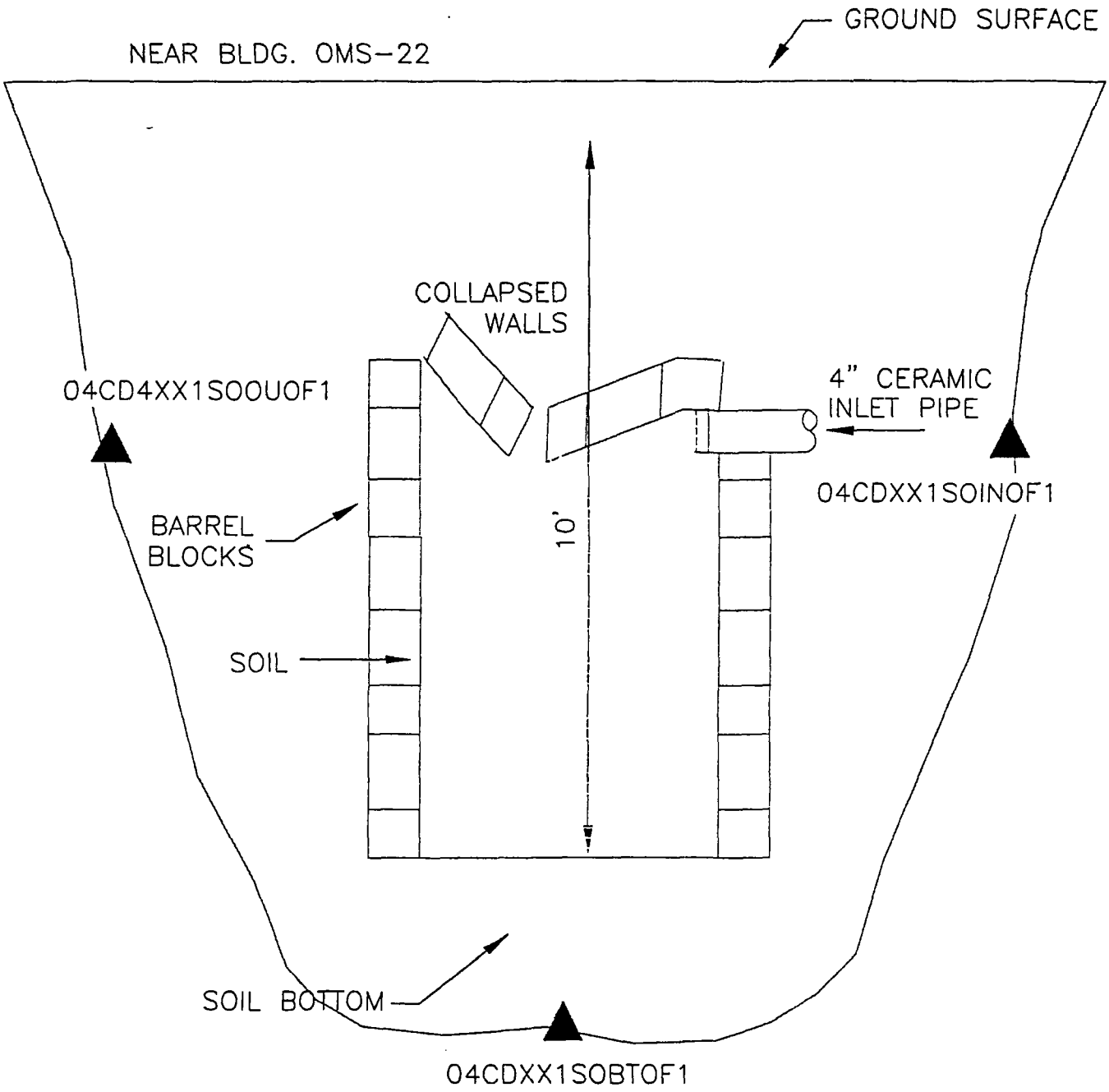
The area of Building OMS-22 is located in the Army National Guard Motor Pool. This structure was not investigated at the time of the Phase I or Phase II Investigations.

2. LIQUID REMOVAL AND DISPOSAL

No liquid was removed from this structure.

3. SEDIMENT/SLUDGE REMOVAL AND DISPOSAL

No sediment/sludge was removed from this structure. The structure was filled with soil which was removed with paylimit.



NOT TO SCALE

▲ Sampling Point

Figure 1
Otis Air National Guard Base
04CDXX1
Cess Pool

Drawn By: S. LEWIS	Jacobs Project Number:	Drawing File Name:
Date: 10/24/96	10K79701	04CDXX1.DWG

JACOBS ENGINEERING GROUP INC.
1300 N. 17th St., Suite 602, Arlington, Virginia 22209

4. DRAINAGE STRUCTURE REMOVAL AND DISPOSAL

4.1 PROCEDURES USED TO REMOVE PAYLIMIT

4.1.1 EXCAVATION

On April 11-12, 1996, a backhoe was used to excavate and remove the drainage structure (Cesspool) and paylimit soils. The soil was removed and directly loaded onto dump trucks. Before excavation began, it was noticed that this structure was partially collapsed. Approximately 40 cubic yards of soil and debris were excavated. Final excavation size was approximately 21 feet long by 15 feet wide by 13 feet deep. Discoloration was present throughout the excavation as well as a strong fuel odor. These areas of discoloration were removed with the paylimit. Approximately 12 linear feet of 4-inch ceramic pipe were removed from the inlet during the excavation. Pipe remaining in the ground was capped with concrete. No outlet pipe was present.

Excavated soil was stored by structure in the CSA. Structure closure was observed by ABB Environmental, the Title II subcontractor to IRP. Photos are located in the photo log of the master copy of this document in the IRP office.

4.1.2 FIELD SCREENING

Field screening for volatile organic compounds and dust was conducted throughout the excavation activities. PID results were non-detect in the breathing zone. Mini-RAM results were also non-detect in the breathing zone. Headspace PID readings were also taken at the inlet, outlet, and bottom. The headspace readings were used as an initial determination of contamination. The headspace readings were 1.0 ppm for the bottom, 2.2 ppm for the inlet, and 1.2 ppm for the outlet sample locations.

4.1.3 BACKFILL

The backfill used for this excavation came from an on-base source, either the former Landfill 1 common borrow pit located on Turpentine Road or paylimit soils from drainage structures with analytical results below the clean fill STCLs. Approximately 60 cubic yards of soil were used to backfill the excavation.

4.1.4 FINAL RESTORATION

A gravel parking area was impacted by the excavation and the area was regraded in the spring.

4.2 ANALYTICAL RESULTS

The on-site and off-site laboratories analyzed the samples according to the Quality Assurance Plan and the laboratory specification (Section 01410 of the Specifications). All data was validated in accordance with HAZWRAP and DOE guidelines. The samples were analyzed for the volatile compounds utilizing EPA method 8010/8020 and EDB, the semivolatile compounds utilized EPA method 8270, pesticides and PCBs by EPA method 8080, metals by EPA method series 6000 and 7000, and TPH by EPA method 8015 modified as diesel and gasoline. The off-site laboratory has established analyte detection levels which are below the method required quantitation levels.

The concentrations reported for those analytes detected below the laboratory quantitation limits are estimated and are noted as such in the following tables.

A sample was collected from the bottom, inlet, and outlet sample locations. The outlet sample was collected from the sidewall opposite the inlet sample because no outlet pipe was present. These samples were analyzed in the on-site laboratory as part of our field screening program. When the on-site laboratory results demonstrated the excavation was clean, samples were sent to the off-site laboratory for confirmation. The off-site analytical detection results for the bottom, inlet, and outlet sample locations are summarized in Tables 4-1 through 4-3, respectively. The complete on-site and off-site analytical data are in Appendix A and B, respectively. None of the compounds detected in the bottom, inlet, and outlet samples exceeded the STCLs; therefore, structure 04CDXX1 is a clean closure.

Table 4-1 - Bottom Sample 04CDXX1SOBTOF1

Analyte	Result	Estimated Quantitation	Exceeds Limits	STCL Outside[1]
TPH as Diesel	61 mg/kg			500 mg/kg
1,4-Dichlorobenzene	3.5 ug/kg			26700 ug/kg
Aluminum	2320 mg/kg			54900 mg/kg
Arsenic	1.7 mg/kg			3.6 mg/kg
Barium	11.9 mg/kg			3800 mg/kg
Beryllium	0.14 mg/kg			1 mg/kg
Calcium	354 mg/kg			
Chromium	6.5 mg/kg			274 mg/kg
Cobalt	1.5 mg/kg			
Copper	20.0 mg/kg			
Iron	3370 mg/kg			
Lead	19.4 mg/kg			300 mg/kg
Magnesium	619 mg/kg			
Manganese	30.4 mg/kg			274 mg/kg
Nickel	1.7 mg/kg			1100 mg/kg
Potassium	424 mg/kg			
Sodium	80.4 mg/kg			
Vanadium	6.5 mg/kg			384 mg/kg
Zinc	8.7 mg/kg			10000 mg/kg
bis(2-Ethylhexyl) phthalate	100 ug/kg	YES		45700 ug/kg
Butyl benzyl phthalate	41 ug/kg	YES		11000000 ug/kg
Fluoranthene	46 ug/kg	YES		2200000 ug/kg
Phenanthrene	48 ug/kg	YES		2200000 ug/kg
Pyrene	50 ug/kg	YES		1650000 ug/kg

[1] STCL is used when the drainage structure was located outside the flightline.

Table 4–2 - Inlet Sample 04CDXX1SOINOF1

Analyte	Result	Estimated Quantitation	Exceeds Limits	STCL Outside[1]
TPH as Diesel	24 mg/kg			500 mg/kg
Aluminum	2420 mg/kg			54900 mg/kg
Arsenic	1.9 mg/kg			3.6 mg/kg
Barium	7.7 mg/kg			3800 mg/kg
Beryllium	0.15 mg/kg			1 mg/kg
Calcium	285 mg/kg			
Chromium	4.1 mg/kg			274 mg/kg
Cobalt	1.2 mg/kg			
Copper	8.8 mg/kg			
Iron	4080 mg/kg			
Lead	6.9 mg/kg			300 mg/kg
Magnesium	506 mg/kg			
Manganese	32.8 mg/kg			274 mg/kg
Nickel	1.6 mg/kg			1100 mg/kg
Potassium	334 mg/kg			
Sodium	85.2 mg/kg			
Vanadium	7.8 mg/kg			384 mg/kg
Zinc	8.9 mg/kg			10000 mg/kg
bis(2-Ethylhexyl) phthalate	40 ug/kg	YES		45700 ug/kg
Butyl benzyl phthalate	43 ug/kg	YES		11000000 ug/kg

[1] STCL is used when the drainage structure was located outside the flightline.

Table 4-3 - Outlet Sample 04CDXX1SOOUOF1

Analyte	Result	Estimated Quantitation	Exceeds Limits	STCL Outside[1]
TPH as Diesel	55 mg/kg			500 mg/kg
Aluminum	3010 mg/kg			54900 mg/kg
Arsenic	2.5 mg/kg			3.6 mg/kg
Barium	7.4 mg/kg			3800 mg/kg
Beryllium	0.16 mg/kg			1 mg/kg
Calcium	329 mg/kg			
Chromium	3.4 mg/kg			274 mg/kg
Cobalt	1.1 mg/kg			
Copper	17.4 mg/kg			
Iron	4930 mg/kg			
Lead	7.7 mg/kg			300 mg/kg
Magnesium	549 mg/kg			
Manganese	32.8 mg/kg			274 mg/kg
Potassium	416 mg/kg			
Sodium	81.7 mg/kg			
Vanadium	8.4 mg/kg			384 mg/kg
Zinc	8.9 mg/kg			10000 mg/kg

[1] STCL is used when the drainage structure was located outside the flightline.

4.3 ANALYTICAL QA

The analytical data were validated in accordance with DOE/HWP - 65/R1: "Requirements for Quality Control of Analytical Data." The validation was a Level C DQO validation and found the data to be usable. Samples were collected from the sidewalls and bottom of the excavation for analysis by an on-site laboratory. This laboratory used gas chromatography and immunoassay techniques for the organic analyses and x-ray fluorescence (XRF) for inorganic analysis. There is good agreement between the on-site and off-site analytical data, with the exception of barium results. The barium concentrations reported by the on-site laboratory are approximately 20 to 40 times the corresponding off-site data. This is caused by differences in analytical methodology. The sample digestion process in the analytical method specified for the off-site laboratory is designed to extract the contaminants from soil matrix samples, not to enable a total soil composition analysis. The XRF technique, however, is non-selective and will detect all barium in a sample, both from contamination and soil composition.

The paylimit and bottom samples were analyzed at a secondary dilution for pesticides/PCBs. There is no impact on data usability for these samples as no compound method detection limits were raised above the applicable STCLs.

Low levels of metallic analytes were detected in the preparation blanks associated with the samples from this structure. For this reason, sodium is considered an artifact in the bottom, inlet, and outlet samples and potassium is considered an artifact in the paylimit sample. As neither element has an applicable STCL, these qualifications have no impact on the overall usability of the data. All other analytes detected in blanks have no effect on the data.

4.4 SOIL FINAL DISPOSITION

The analytical results for the paylimit from this drainage structure were reviewed and are summarized in Table 4-4. The STCL was exceeded for copper. Based on these results the paylimit soils will be treated in the OABF.

Table 4-4 - Paylimit Sample 04CDXX1SOPLOF1

Analyte	Result	Estimated Quantitation	Exceeds Limits	STCL Clean	TCLP Limit	20X Rule
TPH as Diesel	160 mg/kg			500 mg/kg		
1,4-Dichlorobenzene	10 ug/kg			9370 ug/kg	7.5 mg/L	150000 ug/kg
Aluminum	1030 mg/kg			26400 mg/kg		
Arsenic	0.85 mg/kg			3.6 mg/kg	5 mg/L	100 mg/kg
Barium	6.9 mg/kg			3800 mg/kg	100 mg/L	2000 mg/kg
Calcium	261 mg/kg					
Chromium	1.5 mg/kg			6.8 mg/kg	5 mg/L	100 mg/kg
Copper	23.6 mg/kg		YES	19.3 mg/kg		
Iron	1550 mg/kg					
Lead	11.0 mg/kg			15.8 mg/kg	5 mg/L	100 mg/kg
Magnesium	168 mg/kg					
Manganese	17.3 mg/kg			274 mg/kg		
Potassium	195 mg/kg					
Selenium	0.72 mg/kg			7.8 mg/kg	1 mg/L	20 mg/kg
Vanadium	2.5 mg/kg			15.2 mg/kg		
Zinc	4.4 mg/kg			16 mg/kg		
Benzo(b)fluoranthene	38 ug/kg	YES		5000 ug/kg		
Benzo(k)fluoranthene	15 ug/kg	YES		5000 ug/kg		
bis(2-Ethylhexyl) phthalate	220 ug/kg	YES		812 ug/kg		
Butyl benzyl phthalate	55 ug/kg	YES		99300 ug/kg		
Fluoranthene	41 ug/kg	YES		7810 ug/kg		
Pyrene	38 ug/kg	YES		4690 ug/kg		

4.5 DEBRIS FINAL DISPOSITION

The debris from this structure was decontaminated. It will be sorted into suitable and non-suitable debris. The suitable debris will be used for aggregate in the OABF. The unsuitable debris will be sent to a construction debris landfill.

5. APPENDICES

A. ON-SITE ANALYTICAL DATA
B. OFF-SITE ANALYTICAL DATA

APPENDIX A

ON-SITE ANALYTICAL DATA

OTIS AIR NATIONAL GUARD BASE
ON-SITE FIELD SCREENING
SOIL SAMPLE RESULTS
UNITS: PPM

Analyzed: 04/12/96

Analyte	04CDXX1SOBTON1	04CDXX1SOINON1	04CDXX1SOINON1R	04CDXX1800UON1		IN STCL	OUT STCL
DDT	0.200 U	0.200 U	0.200 U	0.200 U		90.000	6.280
PAH	1.000 U	1.000 U	1.000 U	1.000 U		5.000	5.000
PCB	0.130 U	0.130 U	0.130 U	0.130 U		3.830	0.158
TPH AS DIESEL	53.000 U	53.000 U	53.000 U	53.000 U		1200.0	500.00
TPH AS GAS	27.000 U	27.000 U	27.000 U	27.000 U		1200.0	500.00
(trans)-1,2-D	0.010 U	0.010 U	0.010 U	0.010 U		10000	1100.0
1,1-DCE	0.010 U	0.010 U	0.010 U	0.010 U		0.010	0.010
BENZENE	0.010 U	0.010 U	0.010 U	0.010 U		0.010	0.010
ETHYLBENZENE	0.010 U	0.010 U	0.027	0.010 U		0.700	0.700
PCE	0.010 U	0.010 U	0.010 U	0.010 U		0.010	0.010
TCE	0.010 U	0.010 U	0.010 U	0.010 U		0.010	0.010
TOLUENE	0.010 U	0.010 U	0.010 U	0.010 U		1.000	1.000
m+p-XYLENE	0.010 U	0.010 U	0.010 U	0.010 U		10.000	10.000
o-XYLENE	0.010 U	0.010 U	0.027	0.010 U		10.000	10.000
ARSENIC	94.000 U	94.000 U	94.000 U	94.000 U		11.600	3.600
BARIUM	213.000	251.000	225.000	225.000		4070.0	3800.0
CADMIUM	90.000 U	90.000 U	90.000 U	90.000 U		27.300	26.400
CHROMIUM	130.000 U	130.000 U	130.000 U	130.000 U		1160.0	274.00
LEAD	50.000 U	50.000 U	50.000 U	50.000 U		1000.0	300.00
SELENIUM	50.000 U	50.000 U	50.000 U	50.000 U		291.00	274.00
SILVER	50.000 U	50.000 U	50.000 U	50.000 U		291.00	274.00

APPENDIX B

OFF-SITE ANALYTICAL DATA

OFF-SITE ANALYTICAL DATA
BOTTOM SAMPLE

TEST CODE :SPH_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 94 %
TEST NAME : 8010 VOA +EDB (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42398 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOBTOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
Dichlorodifluoromethane	ND		5.3
Chloromethane	ND		5.3
Vinyl chloride	ND		1.1
Bromomethane	ND		0.53
Chloroethane	ND		0.85
Trichlorofluoromethane	ND		0.64
1,1-Dichloroethene	ND		0.53
Methylene chloride	ND		2.6
trans-1,2-Dichloroethene	ND		0.53
1,1-Dichloroethane	ND		0.53
cis-1,2-Dichloroethene	ND		0.53
Chloroform	ND		5.3
1,1,1-Trichloroethane	ND		0.53
Carbon tetrachloride	ND		0.53
1,2-Dichloroethane	ND		0.53
Trichloroethene	ND		1.1
1,2-Dichloropropane	ND		3.2
Bromodichloromethane	ND		2.1
2-Chloroethylvinylether	ND		2.1
cis-1,3-Dichloropropene	ND		0.74
trans-1,3-Dichloropropene	ND		1.6
1,1,2-Trichloroethane	ND		0.53
Tetrachloroethene	ND		2.1
Dibromochloromethane	ND		0.53
Chlorobenzene	ND		0.85
Bromoform	ND		0.53
1,1,2,2-Tetrachloroethane	ND		5.3
1,3-Dichlorobenzene	ND		0.85
1,4-Dichlorobenzene	ND		0.85
1,2-Dichlorobenzene	ND		0.85
Ethylene dibromide	ND		1.1

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SPA_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 94 %
TEST NAME : 8020 VOA (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42398 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOBTOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
MTBE	ND		1.6
Benzene	ND		0.64
Toluene	ND		11
Ethylbenzene	ND		11
Chlorobenzene	ND		1.5
1,3-Dichlorobenzene	ND		1.5
1,4-Dichlorobenzene	3.5		1.3
1,2-Dichlorobenzene	ND		1.3
Total Xylenes	ND		11

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041BTOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42398

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4264

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 6 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	350	U
111-44-4	bis(2-Chloroethyl)Ether	350	U
95-57-8	2-Chlorophenol	350	U
541-73-1	1,3-Dichlorobenzene	350	U
106-46-7	1,4-Dichlorobenzene	350	U
100-51-6	Benzyl Alcohol	350	U
95-50-1	1,2-Dichlorobenzene	350	U
95-48-7	2-Methylphenol	350	U
108-60-1	2,2'-oxybis(1-Chloropropane)	350	U
106-44-5	4-Methylphenol	350	U
621-64-7	N-Nitroso-Di-n-Propylamine	350	U
67-72-1	Hexachloroethane	350	U
98-95-3	Nitrobenzene	350	U
78-59-1	Isophorone	350	U
88-75-5	2-Nitrophenol	350	U
105-67-9	2,4-Dimethylphenol	350	U
65-85-0	Benzoic Acid	1700	U
111-91-1	bis(2-Chloroethoxy)Methane	350	U
120-83-2	2,4-Dichlorophenol	350	U
120-82-1	1,2,4-Trichlorobenzene	350	U
91-20-3	Naphthalene	350	U
106-47-8	4-Chloroaniline	350	U
87-68-3	Hexachlorobutadiene	350	U
59-50-7	4-Chloro-3-Methylphenol	350	U
91-57-6	2-Methylnaphthalene	350	U
77-47-4	Hexachlorocyclopentadiene	350	U
88-06-2	2,4,6-Trichlorophenol	350	U
95-95-4	2,4,5-Trichlorophenol	1700	U
91-58-7	2-Chloronaphthalene	350	U
88-74-4	2-Nitroaniline	1700	U
131-11-3	Dimethylphthalate	350	U
208-96-8	Acenaphthylene	350	U
606-20-2	2,6-Dinitrotoluene	350	U
99-09-2	3-Nitroaniline	1700	U
83-32-9	Acenaphthene	350	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041BTOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42398

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4264

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 6 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
51-28-5	2,4-Dinitrophenol	1700	U
100-02-7	4-Nitrophenol	1700	U
132-64-9	Dibenzofuran	350	U
121-14-2	2,4-Dinitrotoluene	350	U
84-66-2	Diethylphthalate	350	U
7005-72-3	4-Chlorophenyl-phenylether	350	U
86-73-7	Fluorene	350	U
100-01-6	4-Nitroaniline	1700	U
534-52-1	4,6-Dinitro-2-methylphenol	1700	U
86-30-6	N-Nitrosodiphenylamine (1)	350	U
101-55-3	4-Bromophenyl-phenylether	350	U
118-74-1	Hexachlorobenzene	350	U
87-86-5	Pentachlorophenol	1700	U
85-01-8	Phenanthrene	48	J
120-12-7	Anthracene	350	U
86-74-8	Carbazole	350	U
84-74-2	Di-n-Butylphthalate	350	U
206-44-0	Fluoranthene	46	J
92-87-5	Benzidine	1700	U
129-00-0	Pyrene	50	J
85-68-7	Butylbenzylphthalate	41	J
91-94-1	3,3'-Dichlorobenzidine	700	U
56-55-3	Benzo(a)Anthracene	350	U
218-01-9	Chrysene	350	U
117-81-7	bis(2-Ethylhexyl)Phthalate	100	J
117-84-0	Di-n-Octyl Phthalate	350	U
205-99-2	Benzo(b)Fluoranthene	350	U
207-08-9	Benzo(k)Fluoranthene	350	U
50-32-8	Benzo(a)Pyrene	350	U
193-39-5	Indeno(1,2,3-cd)Pyrene	350	U
53-70-3	Dibenz(a,h)Anthracene	350	U
191-24-2	Benzo(g,h,i)Perylene	350	U

(1) - Cannot be separated from Diphenylamine

TEST CODE :SPPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 94 %
TEST NAME : TPH AS GASOLINE UNITS : MG/KG
SAMPLE ID LAB : EE-96-42398 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOBTOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/15/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 7.0 g
FINAL VOLUME: 10 mL INJECTION VOLUME: 100 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Gasoline	ND		5.3

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SCTPH 1

JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT
TEST NAME : TPH AS DIESEL
SAMPLE ID LAB : EE-96-42398
SAMPLE ID CLIENT: 04CDXX1SOBTOF1
SDG # : 42395

%SOLIDS : 94 %
UNITS : MG/KG
MATRIX : SOLID
DATE RECEIVED : 04/13/96
DATE ANALYZED : 04/17/96
DILUTION FACTOR : 1.0
DATE EXTRACTED: 04/15/96
INJECTION VOLUME: 2.0 uL

SAMPLE VOLUME: 25 g
FINAL VOLUME: 1.0 mL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Diesel	61		5.3

QUALIFIERS: C = COMMENT
ND = NOT DETECTED
J = ESTIMATED VALUE
B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SP&PCB1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 94 %
TEST NAME : PESTICIDE-PCB UNITS : MG/KG
SAMPLE ID LAB : EE-96-42398 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOBTOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/18/96
DILUTION FACTOR : 2.0
SAMPLE VOLUME: 30 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 10 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
Aldrin	ND		0.002
alpha-BHC	ND		0.002
beta-BHC	ND		0.002
gamma-BHC (Lindane)	ND		0.002
delta-BHC	ND		0.002
Chlordane	ND		0.017
4,4'-DDD	ND		0.004
4,4'-DDE	ND		0.004
4,4'-DDT	ND		0.011
Dieldrin	ND		0.004
Endosulfan I	ND		0.004
Endosulfan II	ND		0.004
Endosulfan sulfate	ND		0.011
Endrin	ND		0.004
Endrin aldehyde	ND		0.011
Heptachlor	ND		0.002
Heptachlor epoxide	ND		0.002
Toxaphene	ND		0.11
Methoxychlor	ND		0.034
PCB-1016	ND		0.042
PCB-1221	ND		0.042
PCB-1232	ND		0.042
PCB-1242	ND		0.042
PCB-1248	ND		0.042
PCB-1254	ND		0.042
PCB-1260	ND		0.042

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

42398

Lab Name: ECOLOGY_AND_ENVIRONMENT__ Contract: _____

Lab Code: EANDE_ Case No.: 9600.689 SAS No.: _____ SDG No.: 42395_

Matrix (soil/water): SOIL_ Lab Sample ID: 42398

Level (low/med): LOW__ Date Received: 04/13/96

% Solids: _94.2

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2320			P
7440-36-0	Antimony	6.1	U		P
7440-38-2	Arsenic	1.7			P
7440-39-3	Barium	11.9	B		P
7440-41-7	Beryllium	0.14	B		P
7440-43-9	Cadmium	0.49	U		P
7440-70-2	Calcium	354	B		P
7440-47-3	Chromium	6.5			P
7440-48-4	Cobalt	1.5	B		P
7440-50-8	Copper	20.0			P
7439-89-6	Iron	3370			P
7439-92-1	Lead	19.4			P
7439-95-4	Magnesium	619			P
7439-96-5	Manganese	30.4		*	P
7439-97-6	Mercury	0.11	U		CV
7440-02-0	Nickel	1.7	B		P
7440-09-7	Potassium	424	B		P
7782-49-2	Selenium	0.50	U		P
7440-22-4	Silver	0.57	U	N	P
7440-23-5	Sodium	80.4	B		P
7440-28-0	Thallium	0.45	U		P
7440-62-2	Vanadium	6.5			P
7440-66-6	Zinc	8.7		*	P
	Cyanide				NR

Color Before: _____ Clarity Before: _____ Texture: SAND__

Color After: Y_____ Clarity After: C_____ Artifacts: YES___

Comments:

_____CLIENT_SAMPLE_ID:__04CDXX1SOBTOF1_____

OFF-SITE ANALYTICAL DATA
INLET SAMPLE

TEST CODE :SPH_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 95 %
TEST NAME : 8010 VOA +EDB (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42396 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOINOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
Dichlorodifluoromethane	ND		5.3
Chloromethane	ND		5.3
Vinyl chloride	ND		1.0
Bromomethane	ND		0.53
Chloroethane	ND		0.84
Trichlorofluoromethane	ND		0.63
1,1-Dichloroethene	ND		0.53
Methylene chloride	ND		2.6
trans-1,2-Dichloroethene	ND		0.53
1,1-Dichloroethane	ND		0.53
cis-1,2-Dichloroethene	ND		0.53
Chloroform	ND		5.3
1,1,1-Trichloroethane	ND		0.53
Carbon tetrachloride	ND		0.53
1,2-Dichloroethane	ND		0.53
Trichloroethene	ND		1.0
1,2-Dichloropropane	ND		3.2
Bromodichloromethane	ND		2.1
2-Chloroethylvinylether	ND		2.1
cis-1,3-Dichloropropene	ND		0.74
trans-1,3-Dichloropropene	ND		1.6
1,1,2-Trichloroethane	ND		0.53
Tetrachloroethene	ND		2.1
Dibromochloromethane	ND		0.53
Chlorobenzene	ND		0.84
Bromoform	ND		0.53
1,1,2,2-Tetrachloroethane	ND		5.3
1,3-Dichlorobenzene	ND		0.84
1,4-Dichlorobenzene	ND		0.84
1,2-Dichlorobenzene	ND		0.84
Ethylene dibromide	ND		1.0

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Hazardous Waste MANIFEST PROGRAM
79 Elm St., Hartford, CT 06106-5127

FOR STATE USE ONLY

Please type (or print) *(Form designed for use on elite (12-pitch) typewriter.)*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. [illegible] Manifest Document No. [illegible]

2. Page 1 of [illegible]

Information in the shaded areas is not required by Federal law, but may required by State law.

A. State Manifest Document Number: CT F 0650916

B. G.S.I. (Gen. Site Address) [illegible]

C. S.T.L. (Trans. Lic. Plate #) [illegible]

D. Tran. Phone [illegible]

E. S.T.L. (Trans. Lic. Plate #) [illegible]

F. Tran. Phone [illegible]

G. State Facility's ID (Not Required) [illegible]

H. Facility's Phone [illegible]

3. Generator's Name and Mailing Address
THE STATE [illegible]
[illegible] NOBLE ST. MILFORD, [illegible]

4. Generator's Phone ([illegible]) [illegible]

5. Transporter 1 Company Name
[illegible]

6. US EPA ID Number [illegible]

7. Transporter 2 Company Name

8. US EPA ID Number

9. Designated Facility Name and Site Address
UNITED OIL RECOVERY INC
[illegible] AVENUE
MERIDEN, CT [illegible]

10. US EPA ID Number [illegible]

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a. WASTE COMBUSTIBLE LIQUID NOS COMBUSTIBLE LIQUID, [illegible], PGIII	[illegible]	[illegible]	00200	[illegible]	EPA [illegible] STATE [illegible]
b. [illegible]					EPA STATE
c. [illegible]					EPA STATE
d. [illegible]					EPA STATE

J. Additional Descriptions for Materials Listed Above [illegible]

K. Handling Codes for Wastes Listed Above [illegible]

15. Special Handling Instructions and Additional Information
[illegible] EMERGENCY RESPONSE GUIDE [illegible]

Point of Departure: [illegible]

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations, and all applicable State laws and regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name [illegible] | Signature [illegible] | Month Day Year [illegible]

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name Ronald M. Benito | Signature [signature] | Month Day Year 10 [illegible]

18. Transporter 2 Acknowledgement of Receipt of Materials

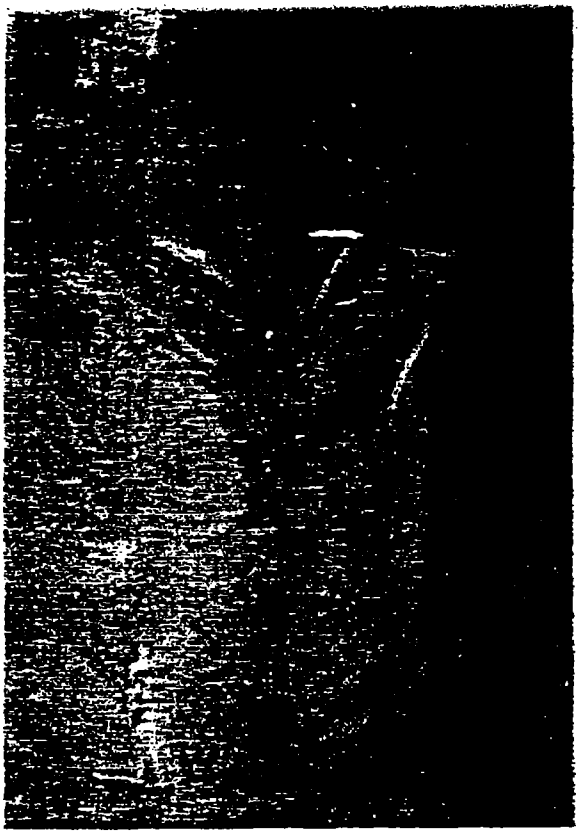
Printed/Typed Name | Signature | Month Day Year

19. Discrepancy Indication Space

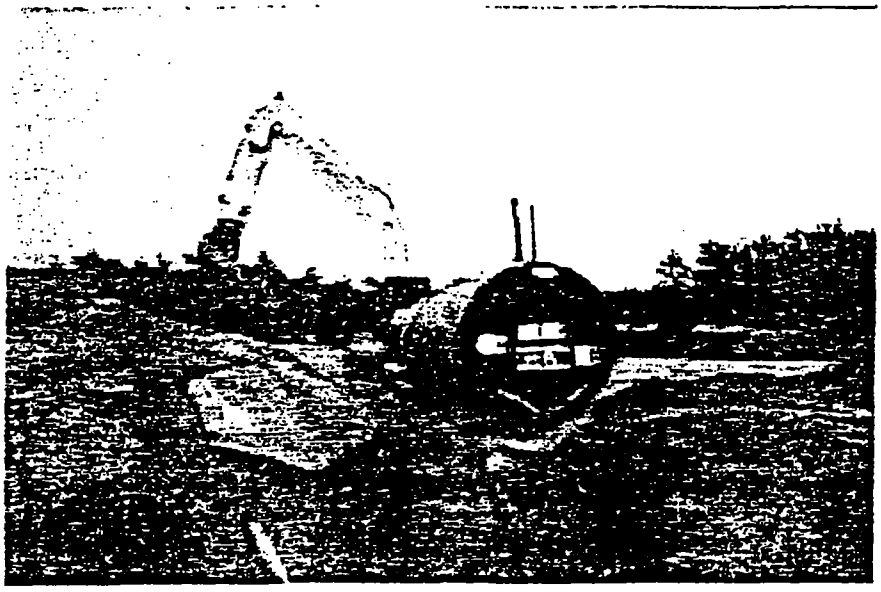
20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | Month Day Year

(A)



(B)



(C)

A. Preparation for removal of tank from Building #5218

B. Tank grave of 12,500 gallon diesel tank OMS#22

C. Extracted tank from OMS#22 adjacent to excavation

TEST CODE :SPA_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 95 %
TEST NAME : 8020 VOA (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42396 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOINOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
MTBE	ND		1.6
Benzene	ND		0.63
Toluene	ND		10
Ethylbenzene	ND		10
Chlorobenzene	ND		1.5
1,3-Dichlorobenzene	ND		1.5
1,4-Dichlorobenzene	ND		1.3
1,2-Dichlorobenzene	ND		1.3
Total Xylenes	ND		10

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041INOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42396

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4262

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 5 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	350	U
111-44-4	bis(2-Chloroethyl)Ether	350	U
95-57-8	2-Chlorophenol	350	U
541-73-1	1,3-Dichlorobenzene	350	U
106-46-7	1,4-Dichlorobenzene	350	U
100-51-6	Benzyl Alcohol	350	U
95-50-1	1,2-Dichlorobenzene	350	U
95-48-7	2-Methylphenol	350	U
108-60-1	2,2'-oxybis(1-Chloropropane)	350	U
106-44-5	4-Methylphenol	350	U
621-64-7	N-Nitroso-Di-n-Propylamine	350	U
67-72-1	Hexachloroethane	350	U
98-95-3	Nitrobenzene	350	U
78-59-1	Isophorone	350	U
88-75-5	2-Nitrophenol	350	U
105-67-9	2,4-Dimethylphenol	350	U
65-85-0	Benzoic Acid	1700	U
111-91-1	bis(2-Chloroethoxy)Methane	350	U
120-83-2	2,4-Dichlorophenol	350	U
120-82-1	1,2,4-Trichlorobenzene	350	U
91-20-3	Naphthalene	350	U
106-47-8	4-Chloroaniline	350	U
87-68-3	Hexachlorobutadiene	350	U
59-50-7	4-Chloro-3-Methylphenol	350	U
91-57-6	2-Methylnaphthalene	350	U
77-47-4	Hexachlorocyclopentadiene	350	U
88-06-2	2,4,6-Trichlorophenol	350	U
95-95-4	2,4,5-Trichlorophenol	1700	U
91-58-7	2-Chloronaphthalene	350	U
88-74-4	2-Nitroaniline	1700	U
131-11-3	Dimethylphthalate	350	U
208-96-8	Acenaphthylene	350	U
606-20-2	2,6-Dinitrotoluene	350	U
99-09-2	3-Nitroaniline	1700	U
83-32-9	Acenaphthene	350	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041INOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42396

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4262

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 5 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
51-28-5	2,4-Dinitrophenol	1700	U
100-02-7	4-Nitrophenol	1700	U
132-64-9	Dibenzofuran	350	U
121-14-2	2,4-Dinitrotoluene	350	U
84-66-2	Diethylphthalate	350	U
7005-72-3	4-Chlorophenyl-phenylether	350	U
86-73-7	Fluorene	350	U
100-01-6	4-Nitroaniline	1700	U
534-52-1	4,6-Dinitro-2-methylphenol	1700	U
86-30-6	N-Nitrosodiphenylamine (1)	350	U
101-55-3	4-Bromophenyl-phenylether	350	U
118-74-1	Hexachlorobenzene	350	U
87-86-5	Pentachlorophenol	1700	U
85-01-8	Phenanthrene	350	U
120-12-7	Anthracene	350	U
86-74-8	Carbazole	350	U
84-74-2	Di-n-Butylphthalate	350	U
206-44-0	Fluoranthene	350	U
92-87-5	Benzidine	1700	U
129-00-0	Pyrene	350	U
85-68-7	Butylbenzylphthalate	43	J
91-94-1	3,3'-Dichlorobenzidine	690	U
56-55-3	Benzo(a)Anthracene	350	U
218-01-9	Chrysene	350	U
117-81-7	bis(2-Ethylhexyl)Phthalate	40	J
117-84-0	Di-n-Octyl Phthalate	350	U
205-99-2	Benzo(b)Fluoranthene	350	U
207-08-9	Benzo(k)Fluoranthene	350	U
50-32-8	Benzo(a)Pyrene	350	U
193-39-5	Indeno(1,2,3-cd)Pyrene	350	U
53-70-3	Dibenz(a,h)Anthracene	350	U
191-24-2	Benzo(g,h,i)Perylene	350	U

(1) - Cannot be separated from Diphenylamine

TEST CODE :SPPH 1

JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 95 %
TEST NAME : TPH AS GASOLINE UNITS : MG/KG
SAMPLE ID LAB : EE-96-42396 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOINOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/15/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 7.0 g
FINAL VOLUME: 10 mL INJECTION VOLUME: 100 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Gasoline	ND		5.3

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT.
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SCTPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 95 %
TEST NAME : TPH AS DIESEL UNITS : MG/KG
SAMPLE ID LAB : EE-96-42396 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOINOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/17/96
DILUTION FACTOR : 1.0
SAMPLE VOLUME: 25 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 1.0 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Diesel	24		5.3

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT.
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SP&PCB1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 95 %
TEST NAME : PESTICIDE-PCB UNITS : MG/KG
SAMPLE ID LAB : EE-96-42396 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOINOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/18/96
DILUTION FACTOR : 1.0
SAMPLE VOLUME: 30 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 10 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
Aldrin	ND		0.001
alpha-BHC	ND		0.001
beta-BHC	ND		0.001
gamma-BHC (Lindane)	ND		0.001
delta-BHC	ND		0.001
Chlordane	ND		0.008
4,4'-DDD	ND		0.002
4,4'-DDE	ND		0.002
4,4'-DDT	ND		0.005
Dieldrin	ND		0.002
Endosulfan I	ND		0.002
Endosulfan II	ND		0.002
Endosulfan sulfate	ND		0.005
Endrin	ND		0.002
Endrin aldehyde	ND		0.005
Heptachlor	ND		0.001
Heptachlor epoxide	ND		0.001
Toxaphene	ND		0.053
Methoxychlor	ND		0.017
PCB-1016	ND		0.021
PCB-1221	ND		0.021
PCB-1232	ND		0.021
PCB-1242	ND		0.021
PCB-1248	ND		0.021
PCB-1254	ND		0.021
PCB-1260	ND		0.021

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

42396

Lab Name: ECOLOGY_AND_ENVIRONMENT__ Contract: _____

Lab Code: EANDE_ Case No.: 9600.689 SAS No.: _____ SDG No.: 42395_

Matrix (soil/water): SOIL_ Lab Sample ID: 42396

Level (low/med): LOW__ Date Received: 04/13/96

% Solids: _95.1

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2420			P
7440-36-0	Antimony	6.0	U		P
7440-38-2	Arsenic	1.9			P
7440-39-3	Barium	7.7	B		P
7440-41-7	Beryllium	0.15	B		P
7440-43-9	Cadmium	0.48	U		P
7440-70-2	Calcium	285	B		P
7440-47-3	Chromium	4.1			P
7440-48-4	Cobalt	1.2	B		P
7440-50-8	Copper	8.8			P
7439-89-6	Iron	4080			P
7439-92-1	Lead	6.9			P
7439-95-4	Magnesium	506	B		P
7439-96-5	Manganese	32.8		*	P
7439-97-6	Mercury	0.11	U		CV
7440-02-0	Nickel	1.6	B		P
7440-09-7	Potassium	334	B		P
7782-49-2	Selenium	0.49	U		P
7440-22-4	Silver	0.57	U	N	P
7440-23-5	Sodium	85.2	B		P
7440-28-0	Thallium	0.44	U		P
7440-62-2	Vanadium	7.8			P
7440-66-6	Zinc	8.9		*	P
	Cyanide				NR

Color Before: _____ Clarity Before: _____ Texture: SAND__

Color After: Y_____ Clarity After: C_____ Artifacts: YES___

Comments:

_____CLIENT_SAMPLE_ID:__04CDXX1SOINOF1_____

FORM I - IN ILM03.0

OFF-SITE ANALYTICAL DATA
OUTLET SAMPLE

TEST CODE :SPH_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 91 %
TEST NAME : 8010 VOA +EDB (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42397 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOOUOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
Dichlorodifluoromethane	ND		5.5
Chloromethane	ND		5.5
Vinyl chloride	ND		1.1
Bromomethane	ND		0.55
Chloroethane	ND		0.88
Trichlorofluoromethane	ND		0.66
1,1-Dichloroethene	ND		0.55
Methylene chloride	ND		2.7
trans-1,2-Dichloroethene	ND		0.55
1,1-Dichloroethane	ND		0.55
cis-1,2-Dichloroethene	ND		0.55
Chloroform	ND		5.5
1,1,1-Trichloroethane	ND		0.55
Carbon tetrachloride	ND		0.55
1,2-Dichloroethane	ND		0.55
Trichloroethene	ND		1.1
1,2-Dichloropropane	ND		3.3
Bromodichloromethane	ND		2.2
2-Chloroethylvinylether	ND		2.2
cis-1,3-Dichloropropene	ND		0.77
trans-1,3-Dichloropropene	ND		1.6
1,1,2-Trichloroethane	ND		0.55
Tetrachloroethene	ND		2.2
Dibromochloromethane	ND		0.55
Chlorobenzene	ND		0.88
Bromoform	ND		0.55
1,1,2,2-Tetrachloroethane	ND		5.5
1,3-Dichlorobenzene	ND		0.88
1,4-Dichlorobenzene	ND		0.88
1,2-Dichlorobenzene	ND		0.88
Ethylene dibromide	ND		1.1

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SPA_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 91 %
TEST NAME : 8020 VOA (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42397 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOOUOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
MTBE	ND		1.6
Benzene	ND		0.66
Toluene	ND		11
Ethylbenzene	ND		11
Chlorobenzene	ND		1.5
1,3-Dichlorobenzene	ND		1.5
1,4-Dichlorobenzene	ND		1.3
1,2-Dichlorobenzene	ND		1.3
Total Xylenes	ND		11

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

0410UOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42397

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4263

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 9 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	360	U
111-44-4	bis(2-Chloroethyl)Ether	360	U
95-57-8	2-Chlorophenol	360	U
541-73-1	1,3-Dichlorobenzene	360	U
106-46-7	1,4-Dichlorobenzene	360	U
100-51-6	Benzyl Alcohol	360	U
95-50-1	1,2-Dichlorobenzene	360	U
95-48-7	2-Methylphenol	360	U
108-60-1	2,2'-oxybis(1-Chloropropane)	360	U
106-44-5	4-Methylphenol	360	U
621-64-7	N-Nitroso-Di-n-Propylamine	360	U
67-72-1	Hexachloroethane	360	U
98-95-3	Nitrobenzene	360	U
78-59-1	Isophorone	360	U
88-75-5	2-Nitrophenol	360	U
105-67-9	2,4-Dimethylphenol	360	U
65-85-0	Benzoic Acid	1800	U
111-91-1	bis(2-Chloroethoxy)Methane	360	U
120-83-2	2,4-Dichlorophenol	360	U
120-82-1	1,2,4-Trichlorobenzene	360	U
91-20-3	Naphthalene	360	U
106-47-8	4-Chloroaniline	360	U
87-68-3	Hexachlorobutadiene	360	U
59-50-7	4-Chloro-3-Methylphenol	360	U
91-57-6	2-Methylnaphthalene	360	U
77-47-4	Hexachlorocyclopentadiene	360	U
88-06-2	2,4,6-Trichlorophenol	360	U
95-95-4	2,4,5-Trichlorophenol	1800	U
91-58-7	2-Chloronaphthalene	360	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	360	U
208-96-8	Acenaphthylene	360	U
606-20-2	2,6-Dinitrotoluene	360	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	360	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041OUOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42397

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4263

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 9 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
51-28-5	2,4-Dinitrophenol	1800	U
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	360	U
121-14-2	2,4-Dinitrotoluene	360	U
84-66-2	Diethylphthalate	360	U
7005-72-3	4-Chlorophenyl-phenylether	360	U
86-73-7	Fluorene	360	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	1800	U
86-30-6	N-Nitrosodiphenylamine (1)	360	U
101-55-3	4-Bromophenyl-phenylether	360	U
118-74-1	Hexachlorobenzene	360	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	360	U
120-12-7	Anthracene	360	U
86-74-8	Carbazole	360	U
84-74-2	Di-n-Butylphthalate	360	U
206-44-0	Fluoranthene	360	U
92-87-5	Benzidine	1800	U
129-00-0	Pyrene	360	U
85-68-7	Butylbenzylphthalate	360	U
91-94-1	3,3'-Dichlorobenzidine	730	U
56-55-3	Benzo(a)Anthracene	360	U
218-01-9	Chrysene	360	U
117-81-7	bis(2-Ethylhexyl)Phthalate	360	U
117-84-0	Di-n-Octyl Phthalate	360	U
205-99-2	Benzo(b)Fluoranthene	360	U
207-08-9	Benzo(k)Fluoranthene	360	U
50-32-8	Benzo(a)Pyrene	360	U
193-39-5	Indeno(1,2,3-cd)Pyrene	360	U
53-70-3	Dibenz(a,h)Anthracene	360	U
191-24-2	Benzo(g,h,i)Perylene	360	U

(1) - Cannot be separated from Diphenylamine

TEST CODE :SPPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 91 %
TEST NAME : TPH AS GASOLINE UNITS : MG/KG
SAMPLE ID LAB : EE-96-42397 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOOUOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/15/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 7.0 g
FINAL VOLUME: 10 mL INJECTION VOLUME: 100 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Gasoline	ND		5.5

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT.
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SCTPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 91 %
TEST NAME : TPH AS DIESEL UNITS : MG/KG
SAMPLE ID LAB : EE-96-42397 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOOUOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/17/96
DILUTION FACTOR : 1.0
SAMPLE VOLUME: 25 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 1.0 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Diesel	55		5.5

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT.
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SP&PCB1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 91 %
TEST NAME : PESTICIDE-PCB UNITS : MG/KG
SAMPLE ID LAB : EE-96-42397 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOOUOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/18/96
DILUTION FACTOR : 1.0
SAMPLE VOLUME: 30 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 10 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
Aldrin	ND		0.001
alpha-BHC	ND		0.001
beta-BHC	ND		0.001
gamma-BHC (Lindane)	ND		0.001
delta-BHC	ND		0.001
Chlordane	ND		0.008
4,4'-DDD	ND		0.002
4,4'-DDE	ND		0.002
4,4'-DDT	ND		0.005
Dieldrin	ND		0.002
Endosulfan I	ND		0.002
Endosulfan II	ND		0.002
Endosulfan sulfate	ND		0.005
Endrin	ND		0.002
Endrin aldehyde	ND		0.005
Heptachlor	ND		0.001
Heptachlor epoxide	ND		0.001
Toxaphene	ND		0.055
Methoxychlor	ND		0.018
PCB-1016	ND		0.022
PCB-1221	ND		0.022
PCB-1232	ND		0.022
PCB-1242	ND		0.022
PCB-1248	ND		0.022
PCB-1254	ND		0.022
PCB-1260	ND		0.022

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

42397

Lab Name: ECOLOGY_AND_ENVIRONMENT__ Contract: _____

Lab Code: EANDE_ Case No.: 9600.689 SAS No.: _____ SDG No.: 42395_

Matrix (soil/water): SOIL_ Lab Sample ID: 42397

Level (low/med): LOW__ Date Received: 04/13/96

% Solids: _91.4

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3010			P
7440-36-0	Antimony	6.3	U		P
7440-38-2	Arsenic	2.5			P
7440-39-3	Barium	7.4	B		P
7440-41-7	Beryllium	0.16	B		P
7440-43-9	Cadmium	0.50	U		P
7440-70-2	Calcium	329	B		P
7440-47-3	Chromium	3.4			P
7440-48-4	Cobalt	1.1	B		P
7440-50-8	Copper	17.4			P
7439-89-6	Iron	4930			P
7439-92-1	Lead	7.7			P
7439-95-4	Magnesium	549			P
7439-96-5	Manganese	32.8		*	P
7439-97-6	Mercury	0.11	U		CV
7440-02-0	Nickel	1.5	U		P
7440-09-7	Potassium	416	B		P
7782-49-2	Selenium	0.51	U		P
7440-22-4	Silver	0.59	U	N	P
7440-23-5	Sodium	81.7	B		P
7440-28-0	Thallium	0.46	U		P
7440-62-2	Vanadium	8.4			P
7440-66-6	Zinc	8.9		*	P
	Cyanide				NR

Color Before: _____ Clarity Before: _____ Texture: SAND__

Color After: Y_____ Clarity After: C_____ Artifacts: YES__

Comments:

_____CLIENT_SAMPLE_ID:__04CDXX1SOOUOF1_____

FORM I - IN ILM03.

OFF-SITE ANALYTICAL DATA
PAYLIMIT SAMPLE

TEST CODE :SPH_0C1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 92 %
TEST NAME : 8010 VOA +EDB (JE) UNITS : UG/KG
SAMPLE ID LAB : EE-96-42395 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOPLOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
Dichlorodifluoromethane	ND		5.4
Chloromethane	ND		5.4
Vinyl chloride	ND		1.1
Bromomethane	ND		0.54
Chloroethane	ND		0.87
Trichlorofluoromethane	ND		0.65
1,1-Dichloroethene	ND		0.54
Methylene chloride	ND		2.7
trans-1,2-Dichloroethene	ND		0.54
1,1-Dichloroethane	ND		0.54
cis-1,2-Dichloroethene	ND		0.54
Chloroform	ND		5.4
1,1,1-Trichloroethane	ND		0.54
Carbon tetrachloride	ND		0.54
1,2-Dichloroethane	ND		0.54
Trichloroethene	ND		1.1
1,2-Dichloropropane	ND		3.3
Bromodichloromethane	ND		2.2
2-Chloroethylvinylether	ND		2.2
cis-1,3-Dichloropropene	ND		0.76
trans-1,3-Dichloropropene	ND		1.6
1,1,2-Trichloroethane	ND		0.54
Tetrachloroethene	ND		2.2
Dibromochloromethane	ND		0.54
Chlorobenzene	ND		0.87
Bromoform	ND		0.54
1,1,2,2-Tetrachloroethane	ND		5.4
1,3-Dichlorobenzene	ND		0.87
1,4-Dichlorobenzene	ND		0.87
1,2-Dichlorobenzene	ND		0.87
Ethylene dibromide	ND		1.1

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SPA_0CI

JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT
TEST NAME : 8020 VOA (JE)
SAMPLE ID LAB : EE-96-42395
SAMPLE ID CLIENT: 04CDXX1SOPLOF1
SDG # : 42395

%SOLIDS : 92 %
UNITS : UG/KG
MATRIX : SOLID
DATE RECEIVED : 04/13/96
DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 5.0 g

PARAMETER	RESULTS	Q	QNT. LIMIT
MTBE	ND		1.6
Benzene	ND		0.65
Toluene	ND		11
Ethylbenzene	ND		11
Chlorobenzene	ND		1.5
1,3-Dichlorobenzene	ND		1.5
1,4-Dichlorobenzene	10		1.3
1,2-Dichlorobenzene	ND		1.3
Total Xylenes	ND		11

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

1B

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041PLOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42395

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4265

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 8 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	360	U
111-44-4	bis(2-Chloroethyl)Ether	360	U
95-57-8	2-Chlorophenol	360	U
541-73-1	1,3-Dichlorobenzene	360	U
106-46-7	1,4-Dichlorobenzene	360	U
100-51-6	Benzyl Alcohol	360	U
95-50-1	1,2-Dichlorobenzene	360	U
95-48-7	2-Methylphenol	360	U
108-60-1	2,2'-oxybis(1-Chloropropane)	360	U
106-44-5	4-Methylphenol	360	U
621-64-7	N-Nitroso-Di-n-Propylamine	360	U
67-72-1	Hexachloroethane	360	U
98-95-3	Nitrobenzene	360	U
78-59-1	Isophorone	360	U
88-75-5	2-Nitrophenol	360	U
105-67-9	2,4-Dimethylphenol	360	U
65-85-0	Benzoic Acid	1700	U
111-91-1	bis(2-Chloroethoxy)Methane	360	U
120-83-2	2,4-Dichlorophenol	360	U
120-82-1	1,2,4-Trichlorobenzene	360	U
91-20-3	Naphthalene	360	U
106-47-8	4-Chloroaniline	360	U
87-68-3	Hexachlorobutadiene	360	U
59-50-7	4-Chloro-3-Methylphenol	360	U
91-57-6	2-Methylnaphthalene	360	U
77-47-4	Hexachlorocyclopentadiene	360	U
88-06-2	2,4,6-Trichlorophenol	360	U
95-95-4	2,4,5-Trichlorophenol	1700	U
91-58-7	2-Chloronaphthalene	360	U
88-74-4	2-Nitroaniline	1700	U
131-11-3	Dimethylphthalate	360	U
208-96-8	Acenaphthylene	360	U
606-20-2	2,6-Dinitrotoluene	360	U
99-09-2	3-Nitroaniline	1700	U
83-32-9	Acenaphthene	360	U

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

041PLOF1

Lab Name: E & E INC. Contract:

Lab Code: EANDE Case No.: 689 SAS No.: SDG No.: 42395

Matrix: (soil/water) SOIL Lab Sample ID: 42395

Sample wt/vol: 30.0 (g/mL) G Lab File ID: I4265

Level: (low/med) LOW Date Received: 04/13/96

% Moisture: 8 decanted: (Y/N) N Date Extracted: 04/15/96

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 04/16/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH:

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
51-28-5	2,4-Dinitrophenol	1700	U
100-02-7	4-Nitrophenol	1700	U
132-64-9	Dibenzofuran	360	U
121-14-2	2,4-Dinitrotoluene	360	U
84-66-2	Diethylphthalate	360	U
7005-72-3	4-Chlorophenyl-phenylether	360	U
86-73-7	Fluorene	360	U
100-01-6	4-Nitroaniline	1700	U
534-52-1	4,6-Dinitro-2-methylphenol	1700	U
86-30-6	N-Nitrosodiphenylamine (1)	360	U
101-55-3	4-Bromophenyl-phenylether	360	U
118-74-1	Hexachlorobenzene	360	U
87-86-5	Pentachlorophenol	1700	U
85-01-8	Phenanthrene	360	U
120-12-7	Anthracene	360	U
86-74-8	Carbazole	360	U
84-74-2	Di-n-Butylphthalate	360	U
206-44-0	Fluoranthene	41	J
92-87-5	Benzidine	1700	U
129-00-0	Pyrene	38	J
85-68-7	Butylbenzylphthalate	55	J
91-94-1	3,3'-Dichlorobenzidine	720	U
56-55-3	Benzo(a)Anthracene	360	U
218-01-9	Chrysene	360	U
117-81-7	bis(2-Ethylhexyl)Phthalate	220	J
117-84-0	Di-n-Octyl Phthalate	360	U
205-99-2	Benzo(b)Fluoranthene	38	J
207-08-9	Benzo(k)Fluoranthene	15	J
50-32-8	Benzo(a)Pyrene	360	U
193-39-5	Indeno(1,2,3-cd)Pyrene	360	U
53-70-3	Dibenz(a,h)Anthracene	360	U
191-24-2	Benzo(g,h,i)Perylene	360	U

(1) - Cannot be separated from Diphenylamine

TEST CODE :SPPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 92 %
TEST NAME : TPH AS GASOLINE UNITS : MG/KG
SAMPLE ID LAB : EE-96-42395 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOPLOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/15/96
DILUTION FACTOR : 1.0

SAMPLE VOLUME: 7.0 g
FINAL VOLUME: 10 mL INJECTION VOLUME: 100 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Gasoline	ND		5.4

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SCTPH 1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 92 %
TEST NAME : TPH AS DIESEL UNITS : MG/KG
SAMPLE ID LAB : EE-96-42395 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOPLOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/16/96
DILUTION FACTOR : 1.0
SAMPLE VOLUME: 25 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 1.0 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
TPH as Diesel	160		5.4

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT.
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

TEST CODE :SP&PCB1 JOB NUMBER :9600.689
ELAP ID : 10486

Ecology and Environment, Inc.
Analytical Services Center

CLIENT : JG-4000 OTIS AIR FORCE BASE
RESULTS IN DRY WEIGHT %SOLIDS : 92 %
TEST NAME : PESTICIDE-PCB UNITS : MG/KG
SAMPLE ID LAB : EE-96-42395 MATRIX : SOLID
SAMPLE ID CLIENT: 04CDXX1SOPLOF1 DATE RECEIVED : 04/13/96
SDG # : 42395 DATE ANALYZED : 04/18/96
DILUTION FACTOR : 5.0
SAMPLE VOLUME: 30 g DATE EXTRACTED: 04/15/96
FINAL VOLUME: 10 mL INJECTION VOLUME: 2.0 uL

PARAMETER	RESULTS	Q	QNT. LIMIT
Aldrin	ND		0.005
alpha-BHC	ND		0.005
beta-BHC	ND		0.005
gamma-BHC (Lindane)	ND		0.005
delta-BHC	ND		0.005
Chlordane	ND		0.043
4,4'-DDD	ND		0.011
4,4'-DDE	ND		0.011
4,4'-DDT	ND		0.027
Dieldrin	ND		0.011
Endosulfan I	ND		0.011
Endosulfan II	ND		0.011
Endosulfan sulfate	ND		0.027
Endrin	ND		0.011
Endrin aldehyde	ND		0.027
Heptachlor	ND		0.005
Heptachlor epoxide	ND		0.005
Toxaphene	ND		0.27
Methoxychlor	ND		0.087
PCB-1016	ND		0.11
PCB-1221	ND		0.11
PCB-1232	ND		0.11
PCB-1242	ND		0.11
PCB-1248	ND		0.11
PCB-1254	ND		0.11
PCB-1260	ND		0.11

QUALIFIERS: C = COMMENT ND = NOT DETECTED
J = ESTIMATED VALUE B = ALSO PRESENT IN BLANK
X = EXCEEDS CALIBRATION LIMIT
N = ANALYTE WAS NOT CONFIRMED BY ALTERNATE PROCEDURE
A = PHENOMENON OF METHODOLOGY WITH ACID PRESERVATION

U.S. EPA - CLP

1

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

42395

Lab Name: ECOLOGY_AND_ENVIRONMENT__ Contract: _____

Lab Code: EANDE_ Case No.: 9600.689 SAS No.: _____ SDG No.: 42395_

Matrix (soil/water): SOIL_ Lab Sample ID: 42395

Level (low/med): LOW__ Date Received: 04/13/96

% Solids: _91.8

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1030			P
7440-36-0	Antimony	6.2	U		P
7440-38-2	Arsenic	0.85	B		P
7440-39-3	Barium	6.9	B		P
7440-41-7	Beryllium	0.07	U		P
7440-43-9	Cadmium	0.50	U		P
7440-70-2	Calcium	261	B		P
7440-47-3	Chromium	1.5			P
7440-48-4	Cobalt	0.90	U		P
7440-50-8	Copper	23.6			P
7439-89-6	Iron	1550			P
7439-92-1	Lead	11.0			P
7439-95-4	Magnesium	168	B		P
7439-96-5	Manganese	17.3		*	P
7439-97-6	Mercury	0.11	U		CV
7440-02-0	Nickel	1.5	U		P
7440-09-7	Potassium	195	B		P
7782-49-2	Selenium	0.72			P
7440-22-4	Silver	0.59	U	N	P
7440-23-5	Sodium	70.9	U		P
7440-28-0	Thallium	0.46	U		P
7440-62-2	Vanadium	2.5	B		P
7440-66-6	Zinc	4.4		*	P
	Cyanide				NR

Color Before: _____ Clarity Before: _____ Texture: SAND__

Color After: Y_____ Clarity After: C_____ Artifacts: YES___

Comments:

_____CLIENT_SAMPLE_ID:__04CDXX1SOPLOF1_____