



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 1

JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

March 31, 1999

Lt. Col. Jim Lyon, Chief
Env. Restoration Div. AFCEE/HQ
3207 North Road, Box 41
Brooks AFB, TX 78235-5363

Re: Five-Year Review Report, Massachusetts Military Reservation

Dear Lt. Col. Lyon:

This office is in receipt of the AFCEE's *Five-Year Review Report, Massachusetts Military Reservation, Installation Restoration Program* dated March 1999. Upon review of the above referenced correspondence, EPA concurs with the findings that all remedies which have been implemented are protective of human health and the environment, and those operable units which are currently undergoing investigation or have proposed remedies, have one or more actions implemented (i.e., access restrictions, public water supply hookups, frequent collection and screening of water supply samples, etc.) to insure the protection of human health and the environment.

Based on EPA's *Supplemental Five-Year Review Guidance, Office of Solid Waste and Emergency Response (OSWER) Directive 9355-02A* (August 1994), "when a Region conducts a five-year review after the time it is due, the next five-year review is due within five years of the time when it was originally required". This five-year review was triggered by the Chemical Spill-4 Remedial Action start of October 15, 1992, and therefore was due October 15, 1997. In summary, the next statutory required five-year review will be due October 15, 2002.

Sincerely,

A handwritten signature in cursive script, reading "Patricia L. Meaney", is positioned above the typed name.

Patricia L. Meaney, Director
Office of Site Remediation and Restoration

cc: Jim Snyder, AFCEE
Len Pinaud, MA DEP
Dave Hill, Bregman and Company
Mike Jasinski, EPA
Mary Sanderson, EPA
Todd Borci, EPA

US copy



FIVE-YEAR REVIEW REPORT

*Massachusetts Military Reservation
Installation Restoration Program*

The Air Force Center for Environmental Excellence

March 1999

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ACRONYMS

AEHA	U.S. Army Environmental Hygiene Agency
AFCEE	Air Force Center for Environmental Excellence
AFCEE HQ	Air Force Center for Environmental Excellence Headquarters
AF/ILEVR	Installation Logistics Environmental Restoration, HQ USAF
AFS	Air Force Station
ANG	Air National Guard
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substance and Disease Registry
AVS	acid volatile sulfides
AVGAS	aviation gasoline
AVLUBE	aviation lubrication
AWOC	ambient water quality criteria
BAF	bioaccumulation factor
BAP	benzo(a)pyrene
BBM	Buzzards Bay Moraine
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BMX	bicycle motorcross
BOMARC	Boeing Michigan Aeronautical Research Center
BS	soil boring
BTEX	benzene, toluene, ethylbenzene, and xylene
BX	Base Exchange Store
CCL	Construction Completion List
CDM	Camp Dresser & McKee Federal Program Corp. (contractor)
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CI/PA	Community Involvement/Public Affairs
CLP	Contract Laboratory Program
CNS	central nervous system
COC	contaminant of concern
CPC	contaminant of potential concern
CPT	current product tanks
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
CS	chemical spill
CSF	cancer slope factor
CWA	Clean Water Act
CY	coal yard



DBCP	1,2-dibromo-3-chloropropane
DCA	dichloroethane
DCE	dichloroethylene
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEQE	Department of Environmental Quality Engineering (MADEP)
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DDOU	Drum Disposal Operable Unit
DPDO	Defense Property Disposal Office
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DSRP	Drainage Structure Removal Program
EDB	ethylene dibromide
ELCD	electrolytic conductivity detector
EOEA	Executive Office of Environmental Affairs, Commonwealth of Massachusetts
EP	equilibrium partitioning
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ETR	extraction treatment reinjection
FE	facility engineer
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
FID	flame ionization detector
FIW	Fighter Interceptor Wing
FOCL	fiber optic communication line
FS	fuel spill
FSP	field sampling plan
FTA	fire training area
GAC	granular activated carbon
GC	gas chromatograph
GC/MS	gas chromatography/mass spectrometry
GPR	ground-penetrating radar
HARM	Hazardous Assessment Rating Methodology
HAS	hollow-stem auger
HEC	Hazard Equivalent Concentration
HI	hazard index
HLA	Harding Lawson Associates



HMX	explosive compound; octahydro-1,3,5,7-tetranito-1,3,5,7-tetrazine; also know as "octogen"
HQ	hazard quotient
HRF	home range factors
HSL	Hazardous Substance List (metals)
HxCDF	hexachlorodibenzofuran
ICS	interference check sample
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JPO	Joint Program Office
JP-4	jet fuel
LCS	laboratory control sample
LF	landfill
LOAEL	lowest-observed-adverse-effect level
LOEC	lowest-observed-effect concentration
LTM	long term monitoring
MATC	maximum acceptable toxicant concentration
MCL	maximum contaminant level
MCP	Massachusetts Contingency Plan
MADEP	Massachusetts Department of Environmental Protection
MCAWW	Methods for Chemical Analysis of Water and Wastes
MMCL	Massachusetts maximum contaminant level
MMR	Massachusetts Military Reservation
MNHP	Massachusetts National Heritage Program
MOGAS	motor gasoline (leaded)
MSL	mean sea level
MW	monitoring well
NCP	National Oil and Hazardous Substances Contingency Plan
ND	not detected
NFA	No Further Action
NGB	National Guard Bureau
NJ	flagging notation for analytical result, meaning not detected and the quantitation limit is an estimated value
NPL	National Priorities List
NWOU	North West Operable Unit
OLM	(EPA) Organic Leachate Model
OMS	organization maintenance shop
OSWER	Office of Solid Waste and Engineering Response (EPD)
OVM	organic vapor monitor



OWS	oil/water separator
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PAVE-PAWS	Precision Acquisition Vehicle Entry-Phased Array Warning System
PCE	tetrachloroethylene (perchloroethylene)
PCB	polychlorinated biphenyl
PD-680	petroleum distillate
PE	performance evaluation
PFSA	petroleum fuel storage area
PID	photoionization detector
PME	Performance Monitoring Evaluation Report
POL	petroleum, oils, and lubricants
ppm	parts per million
PQL	practical quantitation limit
PRA	preliminary risk assessment
PRE	preliminary risk evaluation
PVC	polyvinyl chloride
RA	Remedial Action
RAH	Risk Assessment Handbook
RBC	risk-based concentration
RDX	explosive compound; hexahydro-1.3.5-trinitro-1.3.5-triazine; also known as "cyclonite"
RfC	reference dose
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
SAF/MIQ	Secretary of the Air Force for Environment, Safety, and Occupational Health
SARA	Superfund Amendments and Reauthorization Act
SD	storm drain
SEM	simultaneously extracted metals
SERGOU	South East Regional Groundwater Operable Unit
SI	Site Investigation
SMCL	Massachusetts Secondary Maximum Contaminant Level
SOP	standard operating procedure
SOW	statement of work
SQL	sample quantitation limit
SRAP	Sump Removal Action Program
SS	surface soil
STCL	soil target cleanup level
STP	sewage treatment plant



SVOC	semivolatile organic compound
SW	surface water
SWOU	Southwest Operable Unit
TAL	target analyte list
TCA	trichloroethane
TCE	trichloroethylene
TCL	target compound list
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TTU	thermal treatment unit
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
UST	underground storage tank
UTES	Unit Training Equipment Site
VA	Veterans Administration
VMB	vehicle maintenance building
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WWII	World War II



1. INTRODUCTION

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 121(c) and National Oil and Hazardous Substances Contingency Plan (NCP) section 300.400(f)(4)(ii) require a review to be conducted, at a minimum, every five (5) years after the initiation of the selected Remedial Action (RA). The purpose of the review is to evaluate system performance to determine whether the RA remains adequately protective of public health and the environment at each individual site.

Consistent with CERCLA and the NCP, the Federal Facilities Agreement (FFA) for the Massachusetts Military Reservation (MMR), dated July 17, 1991, also requires a five-year review be performed five (5) years after the initiation of the selected RA at each site. The trigger date for this statutory review was determined by the RA on site construction of the first operable unit giving rise to a five-year review. For MMR, the trigger site was the RA on-site construction date of the Chemical Spill-4 (CS-4) treatment system. The U.S. Environmental Protection Agency's (EPA's) Office of Solid Waste and Emergency Response (OSWER) *Directive 9355-02A Supplemental Five-Year Review Guidance, August 1994* further states that sites subject to five-year reviews with multiple remedies or operable units should conduct a five-year review for the entire site, which will cover all operable units.

EPA and the Air Force Center for Environmental Excellence (AFCEE) have entered into an agreement that a five-year statutory review addressing all source areas, remedies, and operating units will be conducted for MMR in 1998. This document will become part of the site file.

1.1 Organization of Reports

This five-year review report will cover multiple remedies and operable units contained in the MMR cleanup program. Because some operable units or areas of concern may be active and some inactive, each operable unit in the review will be covered as appropriate to its progress in remediation. Discussions of subsequent remedies or operable units will be incorporated into this review. A summary of the source areas and ground-water plumes for MMR is as follows:

- 20 Sites closed based on a Site Investigation (SI) leading to No Further Action (NFA)—Appendix A
- 4 Sites closed based on a Record of Decision (ROD)—Appendix B
- 14 Sites pending closure based on a SI leading to NFA—Appendix C
- 2 Sites in progress pending RODs requiring NFA—Appendix D
- 15 Sites with RODs with RA in progress—Appendix E
- 13 Sites in progress pending RODs requiring RA or Removal Action—Appendix F
- 9 Sites to be determined (under investigation)—Appendix G

A listing of the areas of concern in each of the above categories is contained in Tables 1 through 7, respectively. Each individual source area/site will be addressed separately in an appendix.



Table 1. Sites closed based on a Site Investigation leading to No Further Action

Code	Site name
CS-7	Chemical Spill-7 Organizational Maintenance Shop 6
CS-9	Chemical Spill-9 Former Main USAF Motor Pool
CS-10	Chemical Spill-10 Tank Wash Operable Unit
CY-2	Coal Yard-2 Former USAF/ANG Coal Yard Storage Yard
FS-15	Fuel Spill-12 Runway #5 Fuel Spill
FS-16	Fuel Spill-16 Helicopter Maintenance
FS-20	Fuel Spill-20 Current Product Tank 88
FS-25	Fuel Spill-25 Building 167 Area Fuel Spill
FS-27	Fuel Spill-27 Connery Avenue Soil Telephone Line Excavation
LF-3	Landfill-3 Northeast Landfill
LF-6	Landfill-6 USN Rubble Landfill
LF-7	Landfill-7 Radar Tube Burial Landfill
USCG/CS-5	United States Coast Guard Chemical Spill-5 Carpentry Shop
USCG/CS-7	United States Coast Guard Chemical Spill-7 Dry Cleaning Facility
USCG/FS-26	United States Coast Guard Fuel Spill-26 Building 3444 Fuel Tank Area USCG
USCG/LF-1	United States Coast Guard Landfill-1 Rubble Landfill
USCG/LF-2	United States Coast Guard Landfill-2 Rubble Landfill
USCG/LF-3	United States Coast Guard Landfill-3 Rubble Landfill
VA/CS-12	Veterans Administration Chemical Spill-12 Cemetery Roads and Grounds Shop
VA/LF-5	Veterans Administration Landfill-5 Cemetery Rubble Landfill

Table 2. Sites closed based on a Record of Decision

Code	Site name
FS-12	Fuel Spill-12 Source
LF-1	Landfill-1 MMR Main Sanitary Landfill Source
USCG/CS-1	United States Coast Guard Chemical Spill-1 Transmitter Site (LTM only)
USCG/CS-3	United States Coast Guard Chemical Spill-3 BX Service Station USCG

Table 3. Sites pending closure based on a Site Investigation leading to No Further Action

Code	Site name
CS-1	Chemical Spill-1 North Truck Road Motor Pool
CS-2	Chemical Spill-2 East Truck Road Motor Pool
CS-3/FS-23	Chemical Spill-3 South Truck Road Motor Pool Fuel Spill-23 South



	Truck Road Fuel Spill
CS-6/FS-22	Chemical Spill-6 Current ANG Maintenance Shop/Fuel Spill-22 ANG Motor Pool
CS-8/FS-21	Chemical Spill-8 Organizational Maintenance Shop 22/Fuel Spill-21 Current Product Tank 90
CS-14	Chemical Spill-14 Building 156 Leach Pit
CY-1/CY-3	Coal Yard-1/Coal Yard-3 Former Army/VA Hospital Coal Yard
FS-3	Fuel Spill-3; Johns Pond Fuel Dump
FS-14	Fuel Spill-14; Range E-3 Fuel Spill
SD-1	Storm Drain-1
USCG/CS-2	United States Coast Guard Chemical Spill-2 Hanger 3170 Areas
USCG/CS-6	United States Coast Guard Chemical Spill-6 Other Maintenance Shops USCG
USCG/FS-2	United States Coast Guard Fuel Spill-2 Hot Asphalt Plant
DSRP	Drainage Structure Removal Program [Basewide]

Table4. Sites in progress pending Records of Decision requiring No Further Action

Code	Site name
FS-17	Fuel Spill-17 Former WWII Motor Pool/Fuel Transfer Point
FS-19	Fuel Spill-19 Former MOGAS Fuel Storage & Point

Table5. Sites with Records of Decision with Remedial Action in progress

Code	Site name
Ashumet Valley	Ashumet Valley Groundwater Operable Unit
CS-4	Chemical Spill-4 Groundwater Operable Unit
CS-10	Chemical Spill-10 Groundwater Operable Unit
Eastern Briarwood	Eastern Briarwood (LTM only)
FS-12	Fuel Spill-12 Groundwater Containment System
FS-28 (SWOU)	South West Operable Unit (SWOU)
FTA-2/LF-2	Fire Training Area-2/Landfill-2
LF-1	Landfill-1 Groundwater Operable Unit
PFSA/FS-10/FS-11	Petroleum Fuel Storage Area/Fuel Spill-10/Fuel Spill-11
SD-2/FS-6/FS-8	Storm Drain-2/Fuel Spill-6/Fuel Spill-8
SD-3/FTA-3/CY-4	Storm Drain-3/Fire Training Area-3/Coal Yard-4
SD-4	Storm Drain-4
SD-5/FS-5	Storm Drain-5 Source/Fuel Spill-5
SD-5	Storm Drain-5 Groundwater Containment System
Western Aquafarm	Western Aquafarm (LTM only)



Table 6. Sites in progress pending Records of Decision requiring Remedial Action or Removal Action

Code	Site name
CS-5	Chemical Spill-5 Former Refueler Maintenance Shop
CS-10/FS-24	Chemical Spill-10/Fuel Spill-24 UTES/BOMARC Site Source
CS-11	Chemical Spill-11 Former Pest Control Area
CS-15	Chemical Spill-15 Former Engine Run Up Area
CS-16/CS-17	Chemical Spill-16/Chemical Spill-17 STP Sludge Disposal
CS-16/CS-17	Chemical Spill-16/Chemical Spill-17 DDOU
FTA-1	Fire Training Area-1 Current Fire Training Area Source
FS-1	Fuel Spill-1 AVGAS Test Dump Site (Source and Plume Area)
FS-4	Fuel Spill-4 Current Product Tank 100/101
FS-7	Fuel Spill-7 Current Product Tank 115
FS-9	Fuel Spill-9 Current Product Tank 108
FS-18	Fuel Spill-18 Fuel Transfer Point
USCG CS-4/USCG FS-1	United States Coast Guard Chemical Spill-4 Hanger 128 Area/United States Coast Guard Fuel Spill-1 Hanger 128 Fuel Spill

Table 7. Sites to be determined (under investigation)

Code	Site name
CS-4 North	Chemical Spill-4 West Truck Road Motor Pool
CS-13	Chemical Spill-13 Former Contractor Yard
CS-18	Chemical Spill-18 Propellant Burning Area
CS-19	Chemical Spill-19 Impact Range Chemical Dump Site
FS-2	Fuel Spill-2 Railroad Fuel Station
FS-13	Fuel Spill-13 Underground Fuel Line Containment (Source Area)
LF-4	Landfill-4 Johns Pond Dump-Off Base
NWOU	North West Operable Unit
SERGOU	South East Regional Groundwater Operable Unit



1.2 Structure of Reports

MMR has multiple remedies and operable units, which will be contained in one five-year review report covering the entire site. Accordingly, EPA has developed a type of review to streamline the five-year review process at sites where remedial action is ongoing. *OSWER Directive 9355.7-02, May 23, 1991* covers three types of five-year reviews (Types I, II, and III). A modified approach (Type IA review) was later developed specifically for sites where remedial action is ongoing and is outlined in a supplemental EPA memorandum *Directive 9355.7-02A, Supplemental Five-Year Review Guidance, August 1994*. The Type IA review emphasizes only relevant protectiveness factors, analyzed at a standard of review appropriate for sites where response is ongoing. Sites generally qualify for a Type IA review until construction is completed and the site qualifies for listing on the Construction Completion List (CCL).

The EPA memorandum *Directive 9355.7-02A, Supplemental Five-Year Review Guidance, August 1994*, states the following items must be addressed in a Type IA review:

Document Review

- ROD summary
- Reports in progress
- Monitoring information

The resulting report should contain the following information:

Report Contents

- Introduction
- Remedial objectives
- Areas of noncompliance
- Recommendations
- Statement of protectiveness
- Next review

The structure of the MMR five-year review will cover the Introduction and Next Five-Year Review segments in Sections 1 and 5, respectively. Each of the listed FFA sites, new sites, and active remediation projects will be addressed in the attached appendices containing the following sections for each individual source area or remedial action:

- Site Name
- Site Description
- Discussion of Remedial Objectives
- Areas of Noncompliance
- Recommendations
- Statement on Remedy's Protection of Human Health and the Environment



These appendices will group sites of similar status as follows:

Appendix A	Sites closed based on a Site Investigation leading to No Further Action
Appendix B	Sites closed based on a Record of Decision
Appendix C	Sites pending closure based on a Site Investigation leading to No Further Action
Appendix D	Sites in progress pending Records of Decision requiring No Further Action
Appendix E	Sites with Records of Decision with Remedial Action in progress
Appendix F	Sites in progress pending Records of Decision requiring Remedial Action
Appendix G	Sites to be determined (under investigation)

A listing of each of the sites in the appendices can be found in the Table of Contents and Tables 1 through 7.



2. REMEDIAL OBJECTIVES

For each site, a discussion of the remedial objectives for that site will be cited or referenced. Important facts from the ROD concerning the objective of the remedial action, if necessary, will be noted in the appendix for that specific site. Applicable or relevant and appropriate requirements (ARARs) will be noted if they apply, or as in the case with many sites at MMR, the Decision Criteria Matrix that was specifically modified for implementation at MMR will be referenced.



3. AREAS OF NONCOMPLIANCE

Each specific site at MMR will be reviewed for areas of noncompliance. Information on areas of noncompliance will be included in the specific appendix for that site. If a site has incurred areas of noncompliance, they will be mentioned in this section, along with the corrective measures taken and eventual outcome. This section will also note any regulatory intervention or resolution agreements. The areas of noncompliance will note any substantial aspect of the remedial action that fails to conform to remedial objectives or any current violation of Federal Regulations relevant to the cleanup program.



4. RECOMMENDATIONS

This section will reference the recommendation for each specific site in its respective appendix. If the site is closed and has regulatory concurrence, this closure will be referenced, and a No Further Action recommendation will be made. Many sites under investigation will require follow-up studies, and the outline of such studies will be mentioned in this section. Sites which are pending or have active remediation activities will discuss the progress of work and the activities not yet completed.

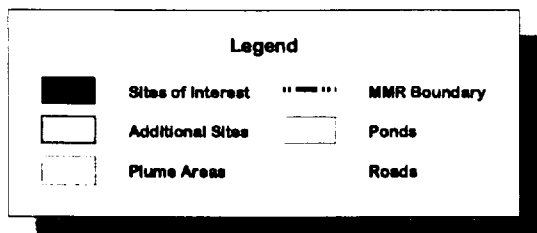
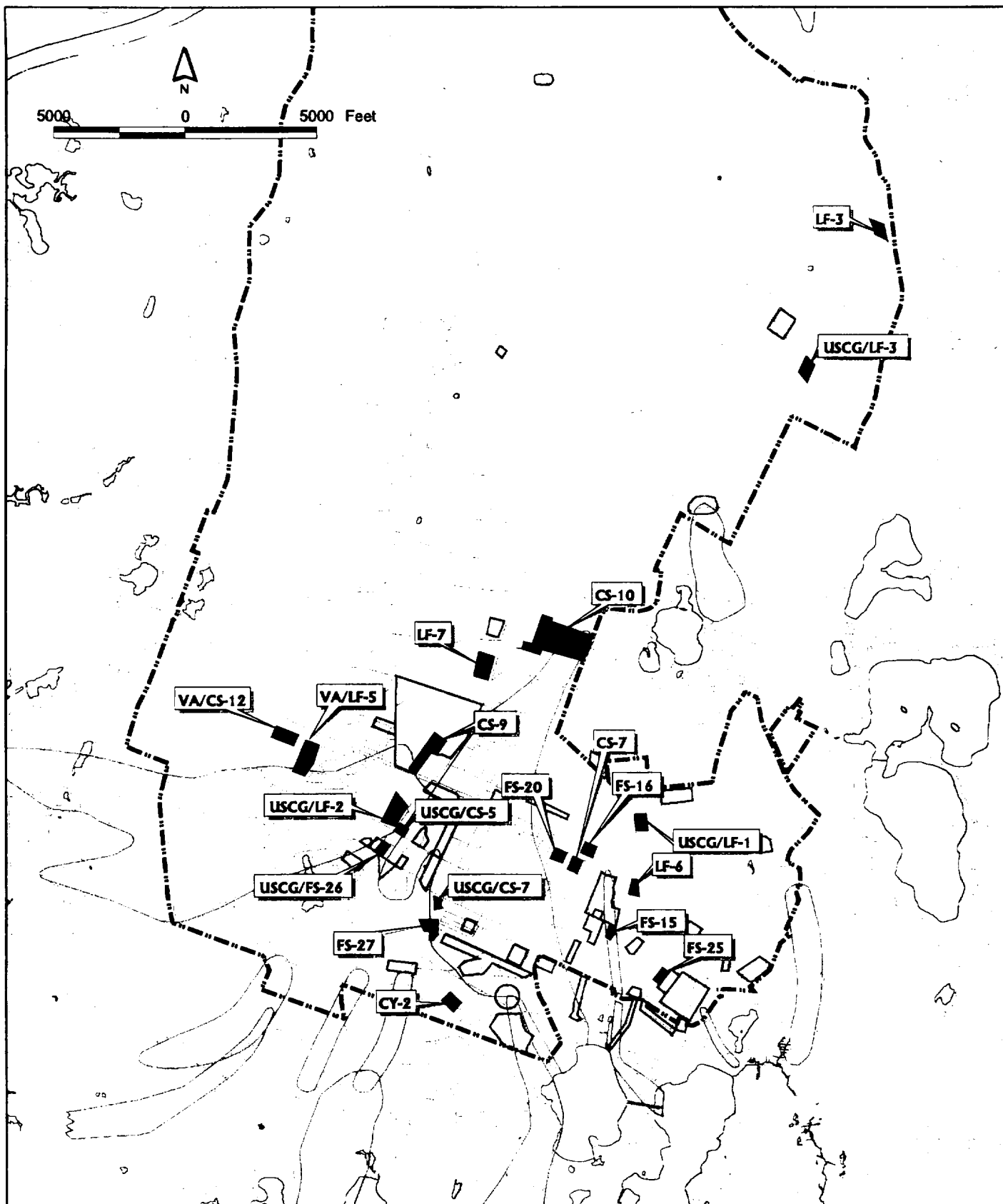


5. NEXT FIVE-YEAR REVIEW

Consistent with CERCLA and the NCP, the FFA for MMR (dated July 17, 1991) requires a five-year review be performed five (5) years after the initiation of the selected RA at each site.

November 1993 marked the completion of physical construction of the first construction fence treatment system or first RA at Chemical Spill 4 (CS-4), thereby initiating the trigger date for the first five-year review in 1998. Given that this first five-year review is occurring in 1998, the next five-year review will be due in 2003. The FFA further states that if, upon such review, it is the conclusion of the parties that additional work is required, the National Guard Bureau (subsequently amended to AFCEE on May 15, 1996) shall submit a schedule to EPA for the implementation of such work.





Prepared for:

MMR
MASSACHUSETTS
MARINE MARIAGE RESTORATION

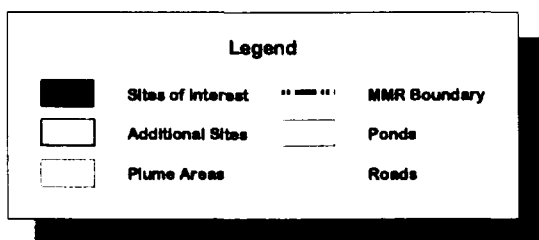
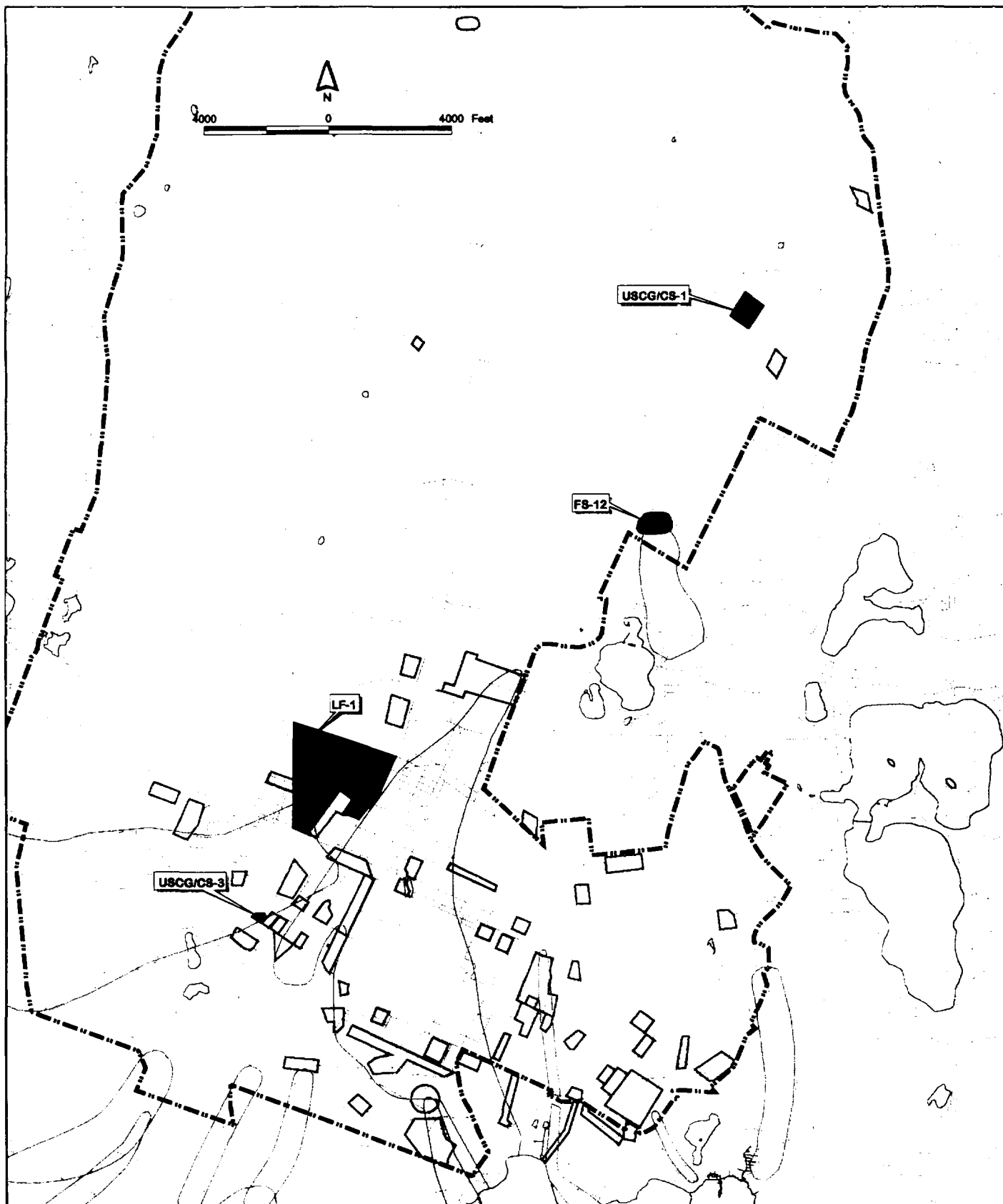
**Installation
Restoration
Program**

**Figure 1. Sites closed
based on a Site Investigation
leading to No Further Action**

Source(s):
Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60a

RADIAN INTERNATIONAL
1000 W. 10TH AVENUE, SUITE 1000
DENVER, CO 80202



Prepared for:

MMR
UNSUBSISTED
MILITARY RESERVATION

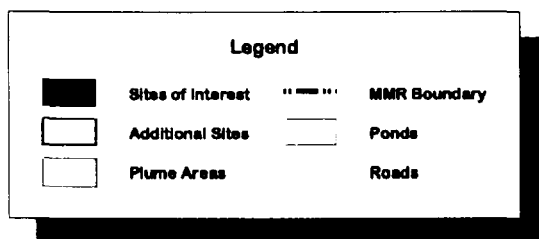
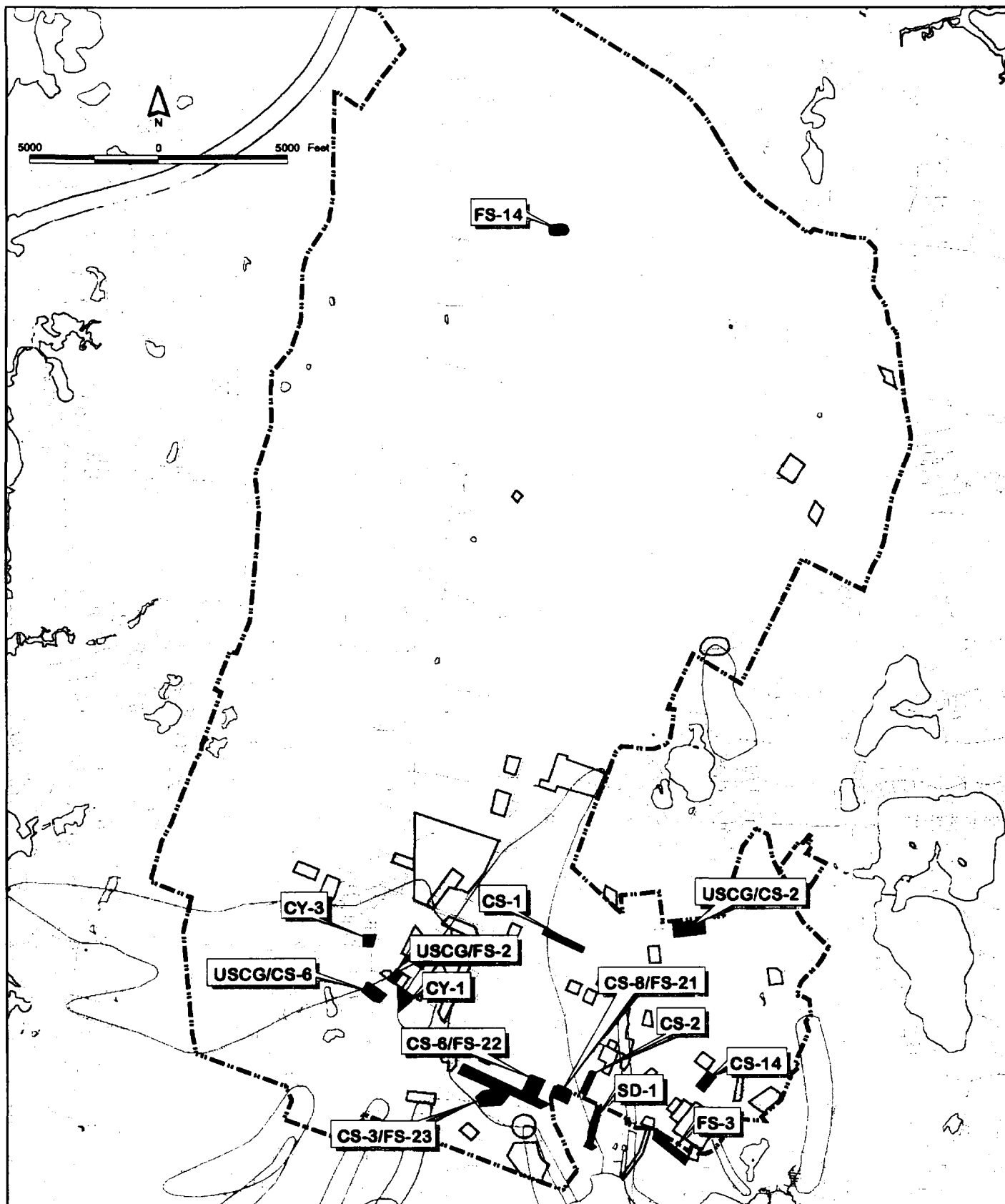
**Installation
Restoration
Program**

**Figure 2. Sites closed
based on a Record of Decision**

Source(s):
Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60b

RADIAN INTERNATIONAL
CONSULTING ENGINEERS



Prepared for:

MMR MASSACHUSETTS MARITIME RESTORATION

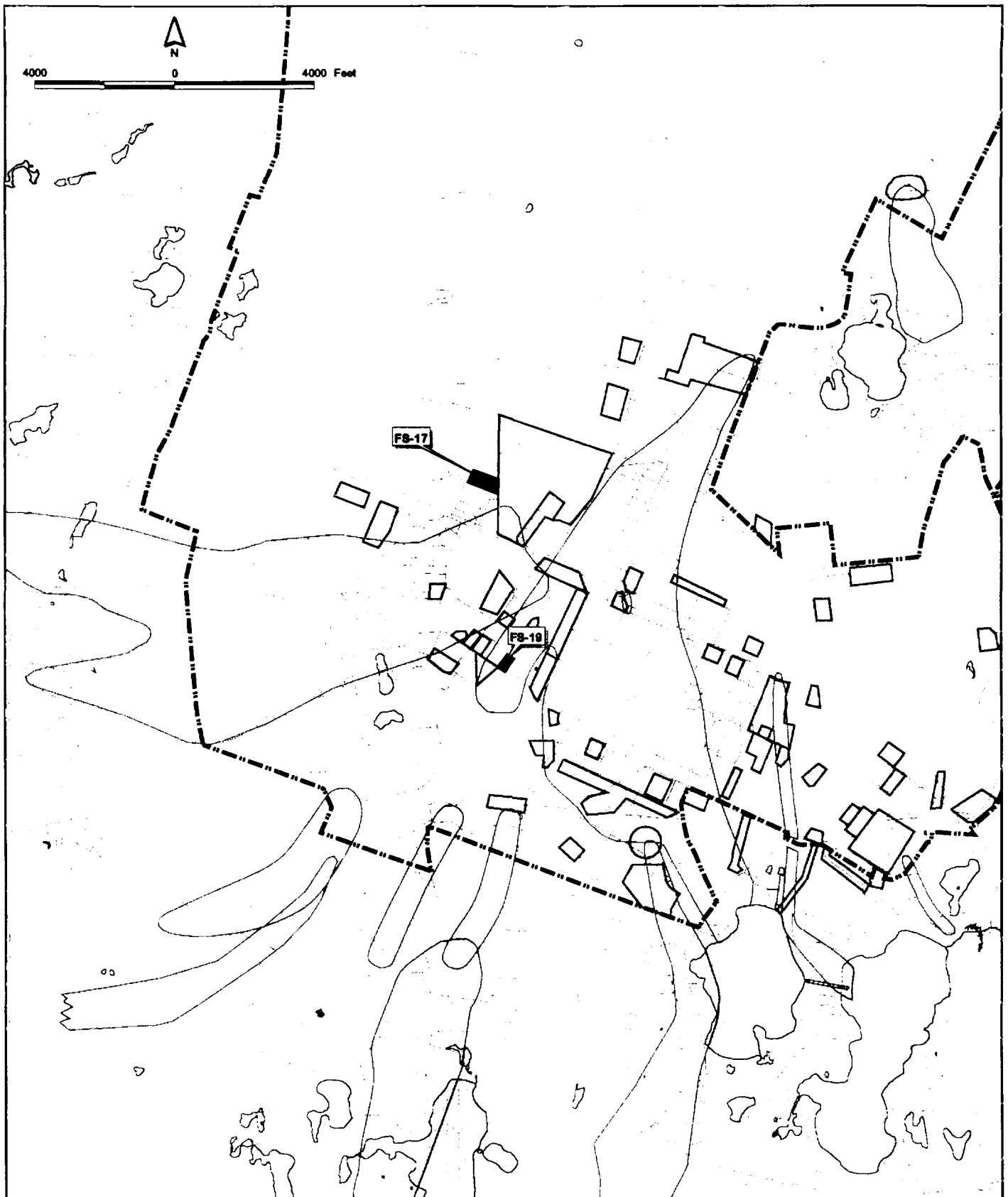
Installation Restoration Program

Figure 3. Sites pending closure based on a Site Investigation leading to No Further Action

Source(s):
Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60c

RADIAN INTERNATIONAL
10000 RIVER ROAD, SUITE 200, FALLS CHURCH, VA 22044



Legend

	Sites of Interest		MMR Boundary
	Additional Sites		Ponds
	Plume Areas		Roads



Prepared for:

MMR MASSACHUSETTS MARITIME RESERVE

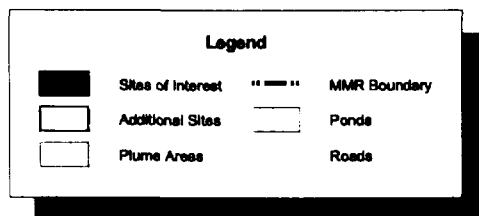
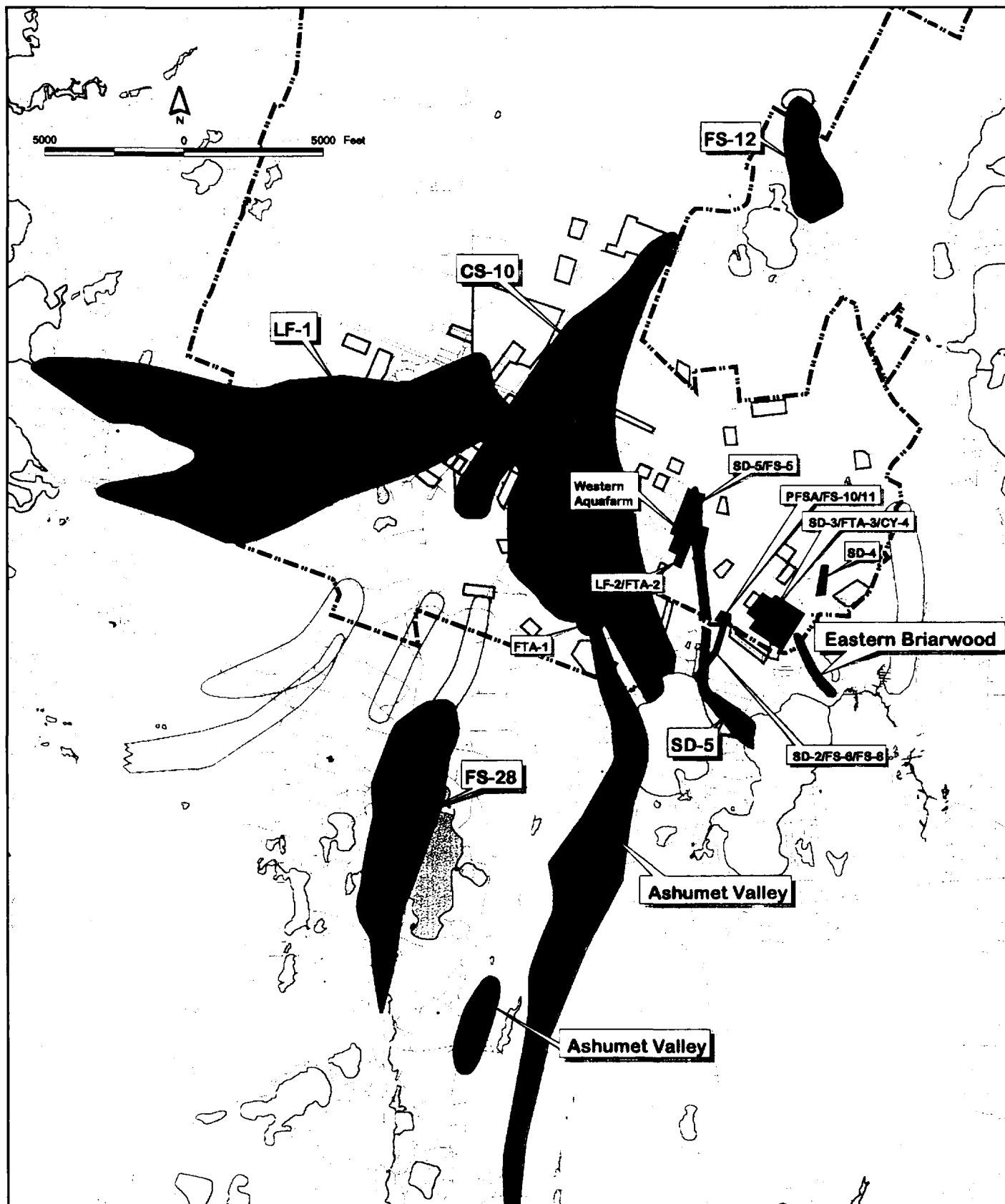
Installation Restoration Program

Figure 4. Sites in progress pending Records of Decision requiring No Further Action

Source(s):
 Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
 Pamela R. Schreiner, Job No. 60d

RADIAN INTERNATIONAL



Prepared for:

MMR
MASSACHUSETTS
MARINE MAMMALS
RESEARCH

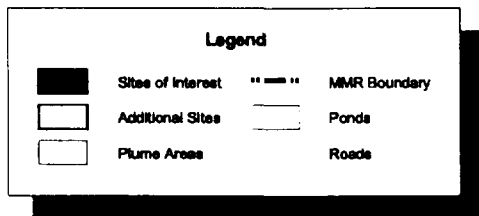
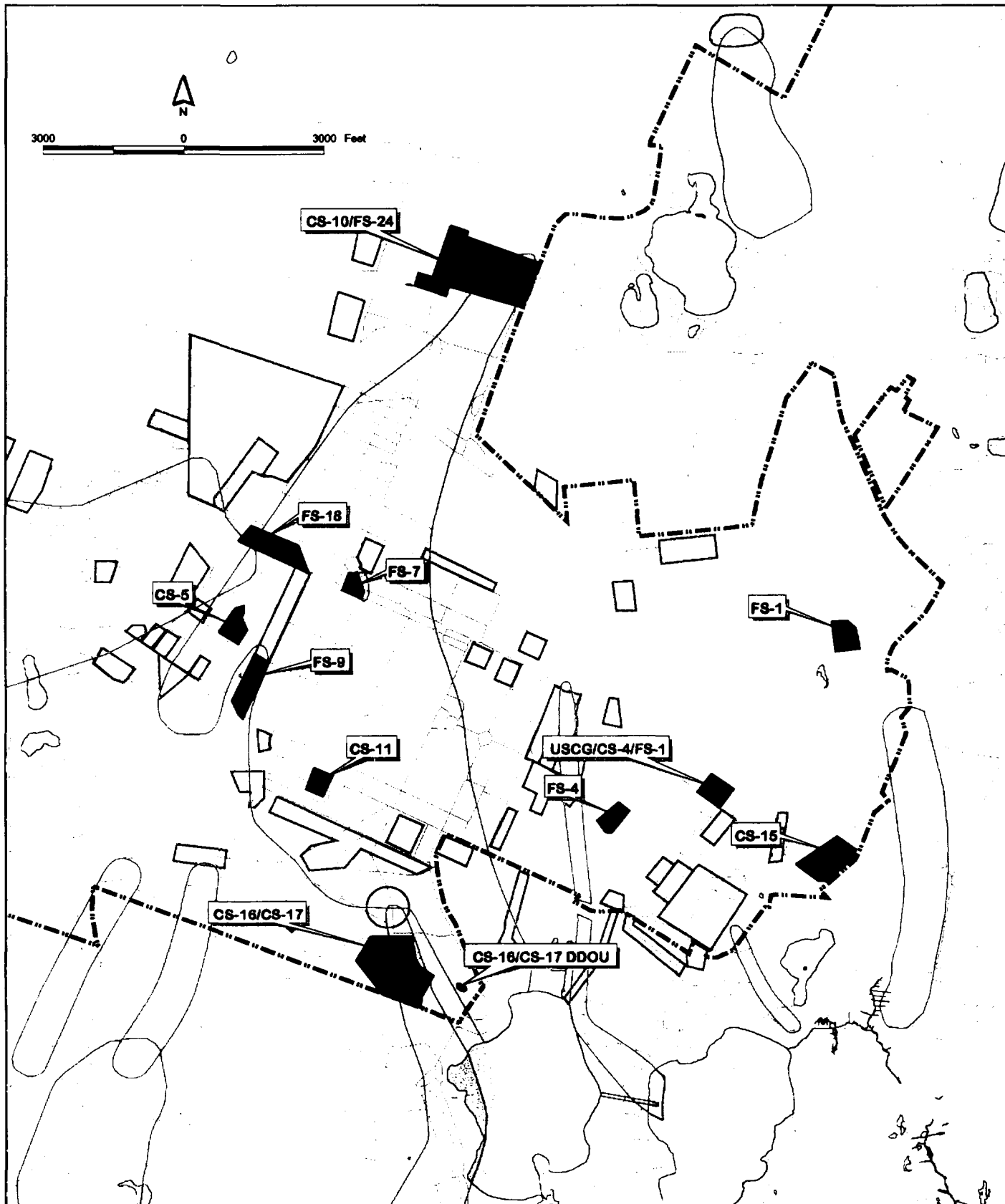
**Installation
Restoration
Program**

**Figure 5. Sites with Records of
Decision with Remedial Action
in progress**

Source(s):
Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60e

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Environmental & Engineering Solutions



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MARINE MAMMAL RESTORATION

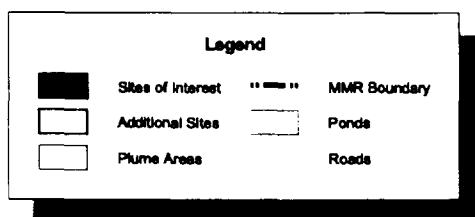
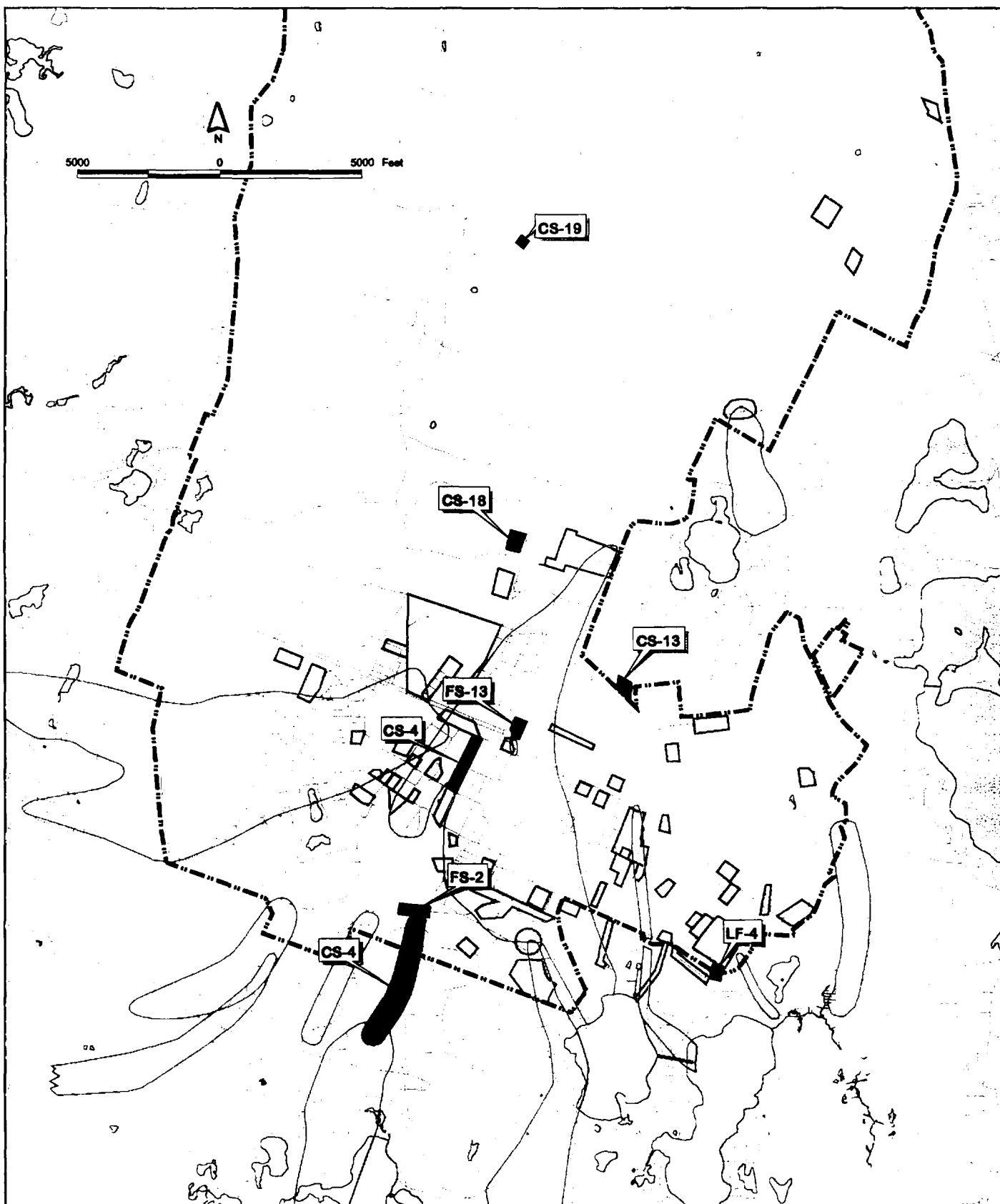
**Installation
Restoration
Program**

**Figure 6. Sites in progress pending
Records of Decision requiring
Remedial Action or Removal Action**

Source(s):
Plume and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60f

RADIAN INTERNATIONAL



Prepared for:

MMR MASSACHUSETTS MILITARY RESERVATION

Installation Restoration Program

Figure 7. Sites to be determined (under investigation)

Source(s):
Phase and source coverages prepared by Jacobs Engineering - March, 1999.

Prepared by:
Pamela R. Schreiner, Job No. 60g

RADIAN INTERNATIONAL

APPENDIX A
Sites Closed out Based on a Site Investigation Leading to No Further Action
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APPENDIX A.1

Site Name: Army National Guard (ANG) Chemical Spill-7 Organizational Maintenance Shop 6

Site Description

Two Organizational Maintenance Shops (OMS) are currently operated by the Massachusetts Army National Guard (ARNG). OMS-6 is located in Building 2806, which was constructed in 1966. Between 1966 and 1974, it was used as a vehicle maintenance shop by ANG. Since then, the shop has been responsible for the maintenance of 140 ARNG vehicles (see Figure 1). A 10,000-gallon unleaded gasoline underground storage tank (UST) is also at OMS-6; this tank has been investigated as Study Area FS-20 and is not included as part of Study Area CS-7. Floor drains at OMS-6 discharge into the storm drainage system. Waste generated at the study area includes waste oil (500 gallons/year), solvents (50 gallons/year), and waste battery electrolyte (35 gallons/year). In the past, waste oil was temporarily stored in a UST prior to disposal off base. This UST was leak-tested in February 1985 and found to be tight. Waste solvents were stored in 55-gallon drums. Until 1985, battery acid was neutralized and discharged to the sanitary sewer. Waste oil and solvents were disposed of off base by the Defense Reutilization and Marketing Office (DRMO). Currently, waste oil is drummed, stored in Building 4600, and sent to the Ft. Devens, Massachusetts DRMO for disposal. Parts-cleaning solvent is provided and disposed of by an outside contractor. Battery acid is currently disposed of through the Ft. Devens, Massachusetts DRMO. No significant spills were reported at this study area.

Discussion of Remedial Objectives

On the basis of information collected during the Preliminary Assessment (PA) study for this area evaluation, including use of the Hazardous Assessment Rating Methodology (HARM) process, this site was recommended for No Further Action (NFA) based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was concurred by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.



March 1999

Statement of the Continued Protection of Human Health and the Environment

Based on these waste disposal practices, no potential for hazardous waste contamination exists at this study area, and the site remains protective of human health and the environment.



APPENDIX A.2

Site Name: Chemical Spill-9 Former Main USAF Motor Pool

Site Description

Study Area CS-9 is a former motor pool located on the northeast side of Connery Avenue (Figure 1). During the Site Investigation (SI), the northern end of Study Area CS-9 contained a bicycle motorcross (BMX) racetrack used by the surrounding communities. According to a BMX track official, in 1993 the track was used one night per week with some special events scheduled on weekend days through the fall. The BMX track is accessed by Beebee Road. As part of the landfill cap construction project, a chain link fence was erected to encompass Beebee Road and the BMX track, restricting access to the LF-1 cover. The BMX track is still active. Except for the BMX track, the study area was nearly level, with most of its surface covered with aging asphalt. Small pine trees and shrubs grew through cracks in the pavement at the study area. No soil staining was evident at the exploration locations. The main base landfill, Area of Contamination (AOC) LF-1, is located north of Study Area CS-9.

From 1941 to 1946, Study Area CS-9 was used by the U.S. Army as a motor pool and vehicle maintenance area. Based on observations during the SI, the motor pool-related buildings have been removed, and most of the study area is unused. Wastes potentially generated during operations included oil, halogenated and nonhalogenated solvents, paint residues, battery electrolytes, antifreeze, and some motor gasoline.

Study Area CS-9 was evaluated as part of the Task 6 Records Search. According to the record search, the U.S. Air Force (USAF) also operated a motor pool at this location from 1955 to 1967. Features observed near the racetrack included former grease and wash racks and an abandoned motor gasoline (MOGAS) refueling system. Wastes potentially generated during operations included oil, halogenated and nonhalogenated solvents, paint residues, battery electrolytes, antifreeze, and a limited amount of MOGAS (E.C. Jordan Co., 1986). During operational periods, vehicle maintenance wastes were reportedly disposed of onto the ground (E.C. Jordan Co., 1986). During SI field investigations, leaching well and sump structures were identified as possible points for waste collection. Four leaching wells and four sumps were located at the former vehicle service areas.

A fifth leaching well was located at the former MOGAS fuel pump island adjacent to the BMX track. The MOGAS refueling system included three USTs and an associated abandoned fuel pump island. AT-19 and AT-20 were 5,000-gallon-capacity steel USTs, each installed in 1941, and a 12,000-gallon-capacity steel UST installed in 1959. According to National Guard Bureau (NGB) records, the USTs were scheduled for removal in 1985 (E.C. Jordan Co., 1986). With the permission of the Commonwealth of Massachusetts, the NGB excavated the tanks in 1985 and moved them elsewhere on the MMR.

The primary source of soil contaminants at Study Area CS-9 is potential releases from the piping network, the sump structures, and grease racks. Intermittent spills of fuel and maintenance fluids represent another potential source of soil contaminants at the study area. Groundwater



underlying this study area is migrating from the Main Base Landfill (AOC LF-1) located immediately upgradient.

Study Area CS-9 soils identified to be contaminated were excavated between March and June of 1994 as part of an accelerated removal action. Uncontaminated soil from the study area and excavated sump structures were used as subgrade fill material in the Main Base Landfill (AOC LF-1) cover system. Contaminated soils were initially stockpiled at AOC CS-4 but were later relocated to AOC FTA-1, where they received treatment in a low-temperature thermal treatment unit (TTU) between August and October of 1995. Approximately 3,663 tons of soil from Study Area CS-9 was treated in the TTU. Following treatment, soils were stockpiled in an on-site storage area and are currently scheduled for use as backfill material for the FTA-1 soil excavation proposed for October of 1996.

Possible contaminant transport pathways include the spills and infiltration of motor pool-related wastes, percolation of contaminants through the soil, and the migration of groundwater containing dissolved-phase contaminants. The potential human receptors include future residents and construction workers. The potential ecological receptors include small mammals and birds.

Discussion of Remedial Objectives

The objectives of this decision document are to describe the history of Study Area CS-9, present results of the SI at Study Area CS-9, present results of the human health and ecological preliminary risk evaluations (PREs), and explain why No Further Action is appropriate for this site.

The subsurface soil and groundwater data indicate that motor pool-related compounds have not migrated vertically within the overburden. Groundwater results showed low levels of fuel- and solvent-type compounds that are likely migrating from upgradient at AOC LF-1, rather than from this study area.

PREs were conducted for human health and the environment. Results of these PREs suggested no unacceptable risks to human health or ecological receptors.

A Remedial Action (RA) summary report has been prepared to provide a detailed summary of Study Area CS-9 soil treatment activities and certification that the RA is completed. *MMR Decision Document Study Area CS-9, Final, June 1998* summarizes the SI findings and results for Study Area CS-9 and provides the rationale for the No Further Action decision.

On the basis of these findings, there is no evidence of significant environmental contamination remaining at Study Area CS-9 that would pose an unacceptable threat to human health or the environment. Concurrence on this decision has been provided by the following regulatory authorities:

Frank J. Ciavattieri, Deputy Director
Office of Site Remediation and Restoration
EPA

1 December 1997



Paul Taurasi
Regional Director
Comm. of Mass. DEP

1 May 1998

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

The soil at Study Area CS-9 that may have been contaminated and, therefore, a potential risk to human and ecological receptors has been excavated and received treatment in a low-temperature TTU. Following treatment, soils were stockpiled in an on-site storage area and used as backfill material for the FTA-1 soil excavation. The sump structures and remainder of the soil from this area were excavated and have been used as fill material beneath the AOC LF-1 landfill cover system.

The potential risks posed by contaminants in the soil have been eliminated by excavating the surface soil. The site remains protective of human health and the environment.



APPENDIX A.3

Site Name: Chemical Spill-10 ANG Tank Wash Operable Unit

Site Description

Site CS-10, located on the eastern boundary of MMR (Figure 1), was developed in 1962 as a Boeing Michigan Aeronautical Research Center (BOMARC) ground-to-air missile defense site. In 1973, the BOMARC facility was decommissioned and transferred from USAF to ANG control. In 1978, Unit Training Equipment Site (UTES) was established at this site. The currently operating tank wash facility for tracked vehicles and heavy trucks at Site CS-10 began operation in 1983; it is located west of the old missile shelter area. Wash water is fed to an oil/water separator. Effluent from the separator drains to a ditch just south of the washing platform.

The tank wash facility was issued a permit to discharge effluent to the ground by the Massachusetts Department of Environmental Quality Engineering in August 1986. At the time the permit was issued, U.S. Army Environmental Hygiene Agency (AEHA) installed three monitoring wells in the tank wash vicinity. One well (AEHA-1A) is hydrogeologically upgradient, and two wells (AEHA-10 and AEHA-11) are hydrogeologically downgradient of the facility. Tank wash effluent and samples from the AEHA monitoring wells are analyzed twice annually for oil and grease, surfactants, volatile organic compounds (VOCs) and pH according to *Guidelines Establishing Test Procedures for the Analysis of the Pollutants under the Clean Water Act* (40 CFR 136). VOCs have not been detected in any samples to date. Detected concentrations of oil and grease, and surfactants are below discharge limits.

No public drinking water wells are located within 0.5 miles of the tank wash facility. In addition, no homes located within 0.5 miles of the Tank Wash Operable Unit receive water from private drinking water wells.

Discussion of Remedial Objectives

SI area studies and monitoring were completed to evaluate the surface and subsurface conditions regarding the presence or absence of hazardous materials. Based on the findings contained in the report titled *Installation Restoration Program, Decision Document, Site CS-10 Tank Wash Operable Unit, February 1990*, a No Further Action decision is made. This decision has regulatory concurrence by the following authority:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.



Statement of the Continued Protection of Human Health and the Environment

SI studies and sampling of the tank wash effluent and three AEHA monitoring wells show no significant contamination of soil or groundwater in the Tank Wash Operable Unit vicinity. Significant chemical source areas were not found through soil gas and boring investigations, and analytical data do not indicate that the tank wash effluent has impacted groundwater quality. Monitoring of the tank wash effluent and AEHA wells will continue according to conditions of the discharge permit and the site remains protective of human health and the environment.



APPENDIX A.4

Site Name: Coal Yard-2 Former United States Air Force/Air National Guard Coal Yard Storage Yard

Site Description

Coal Yard-2 (CY-2), shown in Figure 1, is located less than 1,000 feet from the southern MMR boundary and approximately 1/2-mile northwest of the base sewage treatment plant (STP). Portions of CY-2 are located within the 18.6 acres leased to the municipalities of Falmouth, Sandwich, and Mashpee for a regional solid waste transfer station.

Coal was stockpiled at CY-2 from 1957 to 1984. Most of the coal was piled on a bituminous paved surface. Two railroad spurs, originally used for loading and unloading coal, transect the paved section of the site. North of the paved area, up to 2 feet of coal remains in piles on the ground surface. Runoff from the coal piles is channeled into storm drains that discharge onto the ground at the northern and southern corners of the paved area. A natural northeast-southwest trending natural drainage swale is located at the southeastern section of the site, which extends south of the MMR boundary. The swale has been interrupted just inside the MMR boundary by fill along the right-of-way of Kittredge Road.

Discussion of Remedial Objectives

The objectives of the Decision Document was to describe the history of MMR Site Coal Yard 2 (CY-2), to present the results of investigations at CY-2, and to explain why No Further Action will be taken at this site. This site was initially identified in the PA of MMR (ORNL, 1986) conducted by E.C. Jordan Co. (Jordan). Site CY-2 was further investigated by Jordan in 1988; on the basis of these results, the site was recommended for No Further Action.

A No Further Action decision was made in a report titled *Installation Restoration Program Decision Document Site Coal Yard-2 for Massachusetts Military Reservation, Cape Cod, MA, October 1988*. Regulatory concurrence for this decision was obtained by the following regulatory authorities:

Paul Marchessault (in a separate letter)
United States Environmental Protection Agency, Region 1

16 May 1994

Robert E. Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

18 January 1989

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Site investigations have detected no significant contamination in the soils or groundwater at this



March 1999

site. Residual surface coal will be removed as a good housekeeping measure; therefore, no future contamination of soils or groundwater is likely. On the basis of these findings, there is no significant evidence of environmental risk at the CY-2 site.



APPENDIX A.5

Site Name: Fuel Spill-15 Runway # 5 Fuel Spill

Site Description

In the early 1960s, a plane crashed and burned at the end of Runway No. 5, resulting in a spill of approximately 200 gallons of aviation gasoline (AVGAS) (see Figure 1). The spilled fuel also burned, therefore limiting the amount of fuel that might have otherwise contaminated the soil.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Because the fuel burned as a result of the crash, the potential for contaminant migration into the underlying soils and groundwater was negligible. The site remains protective of human health and the environment.



APPENDIX A.6

Site Name: Fuel Spill-16 Helicopter Maintenance

Site Description

In 1982, a tanker truck spill of approximately 200 gallons of JP-4 was reported. The spill occurred on the tarmac ramp outside Building 2816 (see Figure 1). The spill was washed off onto the surrounding ground. The volume of spilled material would initially have partially volatilized into the atmosphere. Therefore, less than 200 gallons of jet fuel (JP-4) would have been involved.

Based on estimates of petroleum migration in soils (American Petroleum Institute, 1972) a volume of at least 4,000 gallons would be required for JP-4 to reach the water table as a "free-product" phase under the conditions present in this area of MMR. The spilled JP-4 is therefore expected to be completely sorbed to the sands of the vadose zone and to remain entirely within the unsaturated soil zone.

As oil from a spill moves downward through an unconsolidated substrate, a small amount is sorbed to the surface of each particle. Where the available soil surface area is large relative to the volume of oil, the oil will penetrate to a point of residual saturation where the entire oil volume is sorbed to particles and no "free product" flows farther. The volume of soil required to immobilize a given amount of oil depends on two factors: the porosity of the soil and the nature (viscosity) of the hydrocarbon. For the JP-4 spill of 200 gallons a soil volume of approximately 25 cy of soil would be expected to contain all of the spill at its "maximum residual saturation." If the oil were washed to a 1- to 3-square-yard area at the edge of the tarmac, it would be expected to be absorbed in the upper 8 to 25 feet of soil.

After sorption the aromatic compounds would be expected to volatilize and be dissolved in infiltrating water. Because of the age of the spill, the originally present soluble components would have since been lost and degraded. The residual hydrocarbon transformations would also be expected to have stabilized and exhausted all nutrients such that no further transformations would be expected to solubilize additional material.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:



March 1999

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

The amount of material spilled was very small. The small volume of material that would have infiltrated the soil would have remained in the soils and would have since been subject to volatilization and both chemical and biological degradation. Therefore, there is no potential for significant contamination to have reached the water table. Given this information, No Further Action was deemed necessary, and the site remains protective of human health and the environment.



APPENDIX A.7

Site Name: Fuel Spill-20 Current Product Tank 88

Site Description

Current Product Tank No. 88 (Site FS-20) is a 12,500-gallon UST located adjacent to Building 2806 (OMS-6) near the ANG helicopter flight line (Figure 1). The tank, in use since 1968 to store MOGAS, was identified as a potentially leaking tank. Based on an estimated maximum leakage rate of 2.5 liters per hour, up to 108,000 gallons may have been lost over the 18-year life of the tank (E.C. Jordan Co., 1986). Tanks are assumed to leak for life at the rate they leaked upon testing for estimation of total spill volume. However, if a leak is present, it is probably located in the filler pipe, and the quantity lost is at least an order of magnitude lower than the initial estimate.

Discussion of Remedial Objectives

Jordan's assessment of analytical results at Site FS-20 is based on review of historical data for the site and interpretation of findings. Field gas chromatographic results, as well as analytical data reported at estimated levels below contract-required detection limits (CRDLs), were used to interpret the validated analytical results.

Phenanthrene was the only organic compound detected in soil samples. It was found at levels below the CRDL in the soil sample from the water table (59 to 61 feet below ground surface). Phenanthrene is in the class of 2- and 3-aromatic-ring polycyclic aromatic hydrocarbons (PAHs), which are not considered to have carcinogenic properties. PAHs were not detected in the other soil or groundwater samples. The levels of metals detected in the soil samples found at the product tank No. 88 site are low and similar to background concentrations for metals in soil found in the eastern United States. Based on sampling, levels of contamination in the soil at Site FS-20 are not above regulatory levels; therefore, soil at the site is unlikely to impact groundwater quality.

The groundwater sample collected from MW-1 indicates that site soils have not impacted groundwater quality. VOCs and semivolatile organic compounds (SVOCs) were not detected above CRDLs in the groundwater sample.

Manganese was detected in the groundwater at 15 micrograms per liter ($\mu\text{g/L}$). A secondary maximum contaminant level and a Massachusetts groundwater standard of 50 $\mu\text{g/L}$ exist for this compound. The level detected at MW-1 is below the regulatory standards. Manganese also has a very low order of acute oral toxicity. Manganese is ingested by humans as part of regular dietary intake; the average daily consumption per person of manganese in food is 3 to 7 mg (National Academy of Sciences, 1977).

Based on these findings, a No Further Action decision was made and documented in *Installation Restoration Program Decision Document, Site FS-20, Current Product Tank No. 88, Massachusetts Military Reservation, February 1990*. Concurrence on this decision is provided by the following regulatory authorities:



March 1999

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

The site investigation study, which included one test pit and one monitoring well near Product Tank No. 88, indicates no contamination of soil or groundwater at Site FS-20 that poses any health or environmental risks. The soil contains metals at background concentration levels, and only one sample contained an organic constituent (i.e., phenanthrene) at a level below CRDLs. Contaminant source areas do not appear to exist in site soils. Manganese was detected in the groundwater at a level below the state groundwater standard for this compound. Other inorganic chemicals, VOCs, and SVOCs were not detected in groundwater at the site. The absence of residual contamination suggests that neither soil or groundwater quality has been impacted from historical leaks and that the site remains protective of human health and the environment.



APPENDIX A.8

Site Name: Fuel Spill-25 Building 167 Area Fuel Spill

Site Description

Study Area FS-25 covers approximately 1 acre on the southeast portion of MMR (Figure 1). The study area consists of a parking area located immediately northeast of Building 167 on Izzea Street and the approximately 2,000 cy of soil which was excavated from this area in November 1989 and stored temporarily on Taxiway E.

In November 1989, excavation for upgrading the parking lot revealed petroleum-stained soils. Reportedly, some of the soils had a diesel fuel-like odor, which was further substantiated by positive readings on a field photoionization detector (PID). Under direction of the Otis ANG Base civil engineering staff, approximately 2,000 cy of soil was excavated and temporarily stockpiled on abandoned Taxiway E. The age and source of the soil staining are unknown. Possible sources of identified petroleum contamination include heavy equipment maintenance, refueling operations, and/or runoff from the nearby flight line area.

In December 1989, the NGB initiated an investigation program, which involved the collection of soil samples from the excavation site and stockpiled soils on Taxiway E.

The NGB, in consultation with EPA, backfilled the excavation with soils found to contain a total petroleum hydrocarbon (TPH) concentration below the revised target cleanup level; that location is now paved with asphalt. Approximately 100 cy of soil evaluated to have TPH concentrations exceeding the target clean-up level remains on Taxiway E. The 100 cy of soil was treated as part of the thermal treatment of soils from Areas of Contamination FTA-1 and CS-4 (ABB-ES, 1991).

Discussion of Remedial Objectives

In developing remedial objectives for remediating Study Area FS-25 soils, soil contaminant concentrations were compared to applicable standards and/or guidance. No ARARs have been promulgated for contaminants in soil. A Massachusetts policy for excavated petroleum-contaminated soils (DEQE, 1989) was reviewed; however, this policy was not considered directly applicable for Study Area FS-25 because it was developed for virgin petroleum spills (e.g., from leaking USTs). Because the source of Study Area FS-25 soil contamination is unknown, it cannot be assumed that the source of contamination was not waste oil from heavy equipment maintenance or other nonvirgin sources.

Without promulgated ARARs, contaminant concentrations were compared to health- and risk-based policies and guidelines. In the preliminary risk evaluation, carcinogenic and noncarcinogenic risks were calculated and compared with federal limits established in the NCP. The results of the RA based on an average TPH concentration for the stockpiled soils indicated that Study Area FS-25 soils do not pose a significant risk (E.C. Jordan. Co., 1991a).

Because it was considered possible that the stockpiled soils would be returned to the excavation site, the potential impact associated with contaminants from the FS-25 Study Area soils leaching



to groundwater was assessed, using the EPA Organic Leachate Model (OLM) (Federal Register, 1986; 51 FR 41088). As a worst case, ABB-ES assumed that all the stockpiled soil would be returned to the existing excavation and that the soil would be exposed to infiltrating precipitation. Average concentrations of TPHs (expressed as hexane, ethylbenzene, and naphthalene) and 1,1-dichloroethylene (DCE) in soils were used in the OLM to predict the leachate produced due to infiltration. Concentration of these compounds in the leachate concentration was then used in a mass-balance equation to obtain the estimated concentration of the contaminant in groundwater just downgradient of the study area. The calculations and results are present in Appendix A of the feasibility study (E.C. Jordan, 1991b).

To evaluate the impact of the predicted concentrations in groundwater, carcinogenic and noncarcinogenic risk from exposure to 1,1-DCE was calculated to be 3.09×10^{-6} . The total noncarcinogenic hazard index (HI) resulting from exposure to the four modeled compounds was estimated at 0.02. These results indicate that no significant risks are posed by contaminants leaching to groundwater. A soil target level for TPHs was calculated from target groundwater concentrations calculated for the three representative compounds. The target level, based on OLM assumptions for the FS-25 Study Area, was calculated to be 97,800 parts per million (ppm) for the study area composition of TPHs, which is significantly greater than any detected TPH concentration. Thus, any alternative involving placement of the stockpiled soils into the excavation will not pose a risk to groundwater due to contaminant leaching, and no remedial objective was developed for the groundwater-leaching scenario.

Based on the findings of the Technical Report and Feasibility Study, a No Further Action decision is contained in *Installation Restoration Program Decision Document Fuel Spill Site 25 (FS-25) Excavation Site, Final, June 1997*. Regulatory concurrence on this decision is made by the following regulatory authorities:

Paula Fitzsimmons
Chief, Superfund II Branch
United States, Environmental Protection Agency

18 March 1997

Paul Taurasi
Regional Director
Commonwealth of Massachusetts
Department of Environmental Protection

23 October 1996

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Based on findings of the technical report and feasibility study, soils returned to the original excavation having TPH concentrations of less than 1,235 ppm are not considered to pose a threat



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to human health and the environment. The area is now paved over and remains protective of human health and the environment.



APPENDIX A.9

Site Name: Fuel Spill-27 Connery Avenue Telephone Line Soil Excavation

Site Description

Study area FS-27 designates the location of soil stockpiled beneath the overhead power lines off Guenther Road at MMR. Refer to Figure 1 for a map showing the location of Study Area FS-27.

The soil stockpiles, likely contaminated with petroleum hydrocarbons, originated from the installation of approximately 22,000 linear feet of underground fiber optic communication lines (FOCL) at MMR, by an Air National Guard (ANG) contractor, in the fall of 1989. Installation of the FOCL took place along Connery Avenue, West Hospital Road, North Inner Road, and Generals Boulevard.

Two additional areas at MMR are related to FS-27. The first is an embankment behind Building 5202, where excess soil from the installation trenches for the FOCL was used as fill. The second related area is the route of the FOCL, where the soil that was contaminated with petroleum hydrocarbons originated.

While some of the soil from FOCL installation trenches was placed in the Main Base Landfill, the majority of soil was stockpiled beneath the overhead power lines off Guenther Road. Excess soil was used as fill for the embankment behind Building 5202. In the fall of 1990, some soil from the Guenther Road Stockpile was temporarily used as backfill during the excavation of a UST at FS-26 (USCG).

Discussion of Remedial Objectives

MMR Decision Document Study Area Fuel Spill Site No. 27, December 1997 was prepared to support a No Further Action decision at Study Area Fuel Spill 27 (FS-27) and related areas at MMR.

This decision document summarizes evaluations of data that conclude No Further Action is needed on defined media at Study Area FS-27.

The objectives of this decision document are to

- describe and provide the history of Study Area FS-27,
- present results of investigations at Study Area FS-27, and
- explain why No Further Action is appropriate for the defined media.

This document is a summary of information contained in the *Final Preliminary Assessment Report for Study Areas FS-26 and FS-27* (CDM Federal Programs Corp., June 1993), and in the *Final Site Inspection Report, Study Areas CS-1, CS-2, CS-6/FS-22, FS-26 and FS-27* (CDM Federal Programs Corp., August 1996). Additionally, applicable risk sections contained in the *Revised Draft, Site Inspection Report, Study Areas CS-1, CS-2, CS-6/FS-22, FS-26 and FS-27* (CDM Federal Programs Corp., December 1995) and the *Preliminary Risk Evaluation Letter Report for Study Areas FS-26 and FS-27* (CDM Federal Programs Corp., January 1996) have



The No Further Action decision made in the decision document had concurrence from the following regulatory authorities:

Paula Fitzsimmons
Chief, Superfund II Branch
United States, Environmental Protection Agency

18 March 1997

This document is currently awaiting DEP signature

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Field PID and analytical data provide evidence that a petroleum product, or products, were released at FS-27. VOCs and SVOCs are present, but field screening analyses detected no TPH concentrations above 100 ppm in surface soil. Those VOCs and SVOCs present in samples collected from Study Area FS-27 stockpiled soils and media from related areas indicate that most of the compounds typically found in fuels have degraded and weathered.

All calculated human health risk values are within EPA criteria. Results of the ecological PRE indicate that burrowing mammals and passerine birds may be impacted by site contaminants, but given the amount and quality of wildlife habitat, ecological impact by site-related chemicals is unlikely. Therefore, No Further Action is deemed necessary for the defined media.

Statement of the Continued Protection of Human Health and the Environment

A PRE was performed for FS-27 and associated areas. A Preliminary Risk Assessment (PRA) was also performed on portions of the study area at which the PRE indicated additional assessment was prudent. Both the PRE and PRA were conducted according to protocols delineated in the *MMR Risk Assessment Handbook* (RAH), (Automated Sciences Group [ASG], 1993) and in accordance with EPA guidance *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual* (EPA, 1989), *Risk Assessment Guidance for Superfund Volume II: Environmental Evaluation Manual* (EPA, 1989), and other EPA guidance.

All calculated human health risk values are within EPA criteria.



APPENDIX A.10

Site Name: Landfill-3 Northeast Landfill**Site Description**

Based on observations made during an August 22, 1996 visit to the LF-3 study area, the site occupies less than 1 acre near the northeastern edge of MMR (Figure 1). The study area consists of several piles of sand located along the eastern upland edge of a deep, steeply sloping kettle depression. The entire area is wooded except for the sand piles and an unrelated, adjoining area (approximately 20 × 40 feet) that has been recently graded. The study area is accessed via a dirt road, which enters the northeastern (C-16) training area of MMR from Route 130 in Sandwich, Massachusetts. A locked gate marks the point where the dirt road crosses the MMR boundary.

In the spring of 1985 the Facility Engineer (FE) of Camp Edwards noticed an unauthorized disposal area while traveling along the dirt road. The disposal area reportedly included "all manner of household items; trash; construction debris such as Sheetrock waste, concrete piles, dimensional lumber scraps; as well as mattresses, old furniture, and brush piles. There was no evidence of any hazardous waste, empty fuel or paint cans, or drums."

Subsequently, at the FE's direction "approximately two 5-ton dump truck loads of debris" were removed from the disposal area and taken to the main base landfill. In addition, due to the vehicular safety hazard posed by the proximity of the road to the newly exposed steep slope of the kettle depression, the FE instructed the Roads and Grounds foreman to build up the shoulder of the road by dumping clean fill (sand) over the area, thereby restricting vehicular access to the edge of the depression. The Roads and Grounds foreman took the additional measure of installing gates on the dirt road at the access points to MMR from Route 130 to the south and Route 6 to the north to prevent further unauthorized dumping at this or any other areas along the dirt road.

On August 6, 1996 representatives from EPA, Department of Environmental Protection, Army and AFCEE/MMR conducted a site visit at the LF-3 study area. At the time of the visit, the area was observed to be overgrown with trees and shrubs, except for numerous piles of sand located along the upland edge of a steeply sloping kettle depression.

No evidence of waste, debris, or contamination was visible along the edge of the kettle depression or in proximity to the sand piles. An abandoned tire and a rusted fireplace grate were observed along the side of the dirt road in close proximity to the gate (intact and locked) marking the MMR boundary, approximately 100 yards from the sand piles.

Discussion of Remedial Objectives

Based on information obtained from individuals directly involved in the removal of waste from LF-3 study area and the recently observed conditions at the study area, where no waste or evidence of waste or contamination exists, the LF-3 study area is not considered to pose a threat to human health or the environment.



Based on findings, a No Further Action decision was presented in *Massachusetts Military Reservation Final Decision Document Landfill 3, April 1997*. Regulatory concurrence in this document is provided by the following regulatory authorities:

Paula Fitzsimmons
Chief, Superfund II Branch
United States, Environmental Protection Agency

18 March 1997

Paul Taurasi
Regional Director
Commonwealth of Massachusetts
Department of Environmental Protection

2 April 1997

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Because the waste disposed at the study area was not hazardous and was removed from the study area more than 11 years ago and placed with clean sand, there is no current or future risk of exposure to contamination associated with the LF-3 study area.



APPENDIX A.11

Site Name: Landfill-6 USN Rubble Landfill

Site Description

Study Area LF-6 is a former U.S. Navy (USN) landfill, located just west of Runway 5 (see Figure 1). It was used as debris and rubble fill area during expansion of the taxiway area and has since been paved over. Based on this reported use, no evidence of hazardous waste disposal exists.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

There is no evidence that hazardous wastes were disposed of at this location. Therefore, no potential for contamination or contaminant migration exists, and the site remains protective of human health and the environment.



APPENDIX A.12

Site Name: Landfill-7 Radar Tube Burial Ground

Site Description

Study Area LF-7 is located in a gravel pit north of the present sanitary landfill (see Figure 1). It is an area where radioactive electron tubes removed from EC-121 aircraft radar sets were reportedly buried. Since approximately 200 tubes/year were removed from aircraft between 1955 and 1970, it is estimated that as many as 3,000 tubes may be buried. In response to discussions with the EPA on May 19, 1992, ANG investigated the nature of the radioactive isotopes used in the radar tubes disposed at LF-7. ANG and USAF radiation safety officers and bioenvironmental engineering staff were consulted on the nature of the radioactive isotopes used in the electron tubes. However, the stock number of the radar units in which the tubes were installed could not be positively identified. Therefore, the exact isotope identification could not be established.

Based on discussions with ANG and USAF personnel, the most likely radioactive isotopes used in the electron tubes were cesium-137, tritium, nickel-63, cobalt-60, and radium-226. It is also possible that other isotopes were used, since the electron tube manufacturers were required to meet certain performance specifications but the radioactive isotope used in each tube was not specified.

These tubes are believed to have contained very low, near background, levels of radioactive material ranging from 10^{-7} to 10^{-9} picocuries (pCi). Using the estimated number of tubes and their pCi range, the total radioactivity at this study area is calculated to be 3×10^{-4} to 3×10^{-6} pCi. If this entire amount of radioactivity were contained in one (1) liter of water, the level of radioactivity would be, at worst, 3×10^{-4} pCi/L. The EPA Interim Primary Drinking Water Standards for radium and gross alpha radioactivity are 5 pCi/L and 15 pCi/L, respectively. The worst-case concentrations calculated above are negligible compared to federal standards. Actual concentrations maybe considerably lower than the worst-case scenario calculation.

Because of the uncertainty in the identification of the isotope(s) disposed at LF-7, specific discussions regarding the radioactive half-lives cannot be made. The half-lives of the likely isotopes used in the radar electron tubes extend from approximately 5 to 1,620 years. Therefore, the radioactivity in these tubes, which were disposed between 1955 and 1970, is calculated to range from less than 1 percent to 100 percent of that present when the tubes were initially disposed.

Three annual monitoring events have been conducted to date (27 June 1991, 25 June 1992, 17 July 1993) resulting in no radiation levels above background detected. LF-7 measures 20×20 feet; monitoring covers the entire area of the site.

Radiological assessment of tube burials at other USAF study areas, performed as part of the overall USAF IRP, has not reported radiological contaminant migration or human health hazards in association with such study areas.



Discussion of Remedial Objectives

Study Area LF-7 will be operated in full accordance with policy letter of August 9, 1988. This policy specifies that areas used for disposal of low-level radioactive wastes will be appropriately fenced to prevent unauthorized entry, marked with appropriate radioactive warning labels, and monitored annually to verify that actual levels of radioactivity remain acceptable. In addition to the fencing surrounding the disposal site, and in response to EPA concerns, an area surrounding LF-7 will be posted by the ANG to prevent excavation. The area to be posted will be determined by the based on the existing site conditions (i.e., tree cover, accessibility).

The annual radiological survey will be conducted with a Model 471RF survey meter or equivalent. The 20 × 20 foot area will be surveyed at the ground surface and 3 feet above. While this instrument does not detect alpha radiation, monitoring for alpha radiation is not necessary as long as the soil is not disturbed. If the soil is disturbed, air sampling will be conducted to detect alpha radiation. High- and/or low-volume air samplers will be used. Air filters will be screened on site with zinc sulfide (ZnS) scintillation counter or gas proportional counter or be sent off site for laboratory analysis.

These institutional controls will be implemented as long as MMR remains a military base. Levels of radioactivity considered acceptable are (1) less than two times background or (2) 2 milliRoentgen/hour, whichever is lower (Nuclear Regulatory Commission regulations 10 CFR 20.105).

Based on annual monitoring to date, no radiation has been detected above background. A No Further Action recommendation was put forth in a report titled *Installation Restoration Program, Decision Document Radar Tube Burial Landfill (LF-7 Study Area) Massachusetts Military Reservation, Cape Cod, Massachusetts; Final, November 1993*.

Regulatory concurrence with No Further Action authorized by the following:

David Webster	9 December 1993
United States Environmental Protection Agency, Region 1	
George Crombie	27 January 1994
Commonwealth of Massachusetts	
Department of Environmental Protection	

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Based on the level of radioactive materials contained in these tubes, the potential hazard from the disposed radar tubes is negligible. Radiological studies at similar disposal study areas have not indicated contamination or human health impact. The risk does not trigger actions under the



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NCP. This is confirmed by three years of annual monitoring resulting in no concentration above background detected.



APPENDIX A.13

Site Name: United States Coast Guard Chemical Spill-5 Carpentry Shop

Site Description

The Carpentry Shop, located in Building 3456, has operated since 1970 (see Figure 1). Approximately 110 gallons of turpentine is used annually to clean brushes and rollers used in paint application. Only very small quantities of waste paint and turpentine are spilled while being transferred to 55-gallon drums of waste thinner. The drums of waste thinner are stored in a designated area and periodically removed by a DRMO contractor for off-base disposal. Because turpentine is readily biodegradable and only small spill quantities are involved, no significant potential for contamination is considered to exist.

Discussion of Remedial Objectives:

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Because of the nature and small quantities of materials involved, no potential for contamination or contaminant migration exists, and the site remains protective of human health and the environment.



APPENDIX A.14

Site Name: United States Coast Guard Chemical Spill-7 Dry-Cleaning Facility

Site Description

The dry-cleaning facility located in the base launderette (Building 1131) operated from the mid-1960s to 1975 (see Figure 1). Prior to 1975, it was under USAF control. Reportedly, since 1975 the dry-cleaning machines have been nonoperational.

Two 55-gallon drums containing Dowchlor were present in Building 1131 at the time of the on-study area records search. The drums were removed in February 1986 by the United States Coast Guard (USCG) and shipped to DRMO.

The launderette has two coin-operated dry-cleaning machines. When operational, these machines used Dowchlor as the dry-cleaning compound. Dowchlor, which was 96 percent perchloroethylene (PCE), is no longer produced.

The drums of Dowchlor were stored in a utility room located in the back of the building. They were positioned horizontally and were connected to the dry-cleaning units by rubber hoses. Reportedly, during an inspection, a bucket acting as a catch basin was observed beneath one of the drums. According to those who used the facility, the dry-cleaning machines periodically leaked fluid onto the floor in the laundry room. Fluids, possibly including dry-cleaning compound, were also observed on the utility room floor where the drums were stored. Leaking and spilled fluids in Building 1131 are channeled into building floor drains, which empty into the sanitary sewer system.

Because of the potential for past leakage and spills within Building 1131, the dry-cleaning facility could have potentially contributed a source of contamination to Study Area CS-16/CS-17, the MMR Sewage Treatment Plant/Sludge Disposal Area. By itself, however, the dry-cleaning facility is not a study area, since there is no possibility of contaminants having entered either the soils or the groundwater at this location.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal.

This decision for No Further Action required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:



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Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Potential for contaminant migration from Study Area USCG CS-7 via the sanitary sewer system was evaluated as part of the IRP investigation of the MMR Sewage Treatment Plant (Study Area CS-16). However, no potential exists for contamination or contaminant migration at the study area itself, and the area remains protective of human health and the environment.



APPENDIX A.15

Site Name: United States Coast Guard Fuel Spill-26 Building 3444 Fuel Tank Area

Site Description

Study Area FS-26 (USCG) is located at the intersection of two unnamed paved roads at the southwesterly end of Building 3444 (see Figure 1), a USCG warehouse located at the juncture of Turpentine Road, Lee Road, and Beaman Road on MMR, Cape Cod, Massachusetts.

The study area is the former location of a 3000-gallon UST that contained No. 2 heating oil. In 1990, the USCG contracted Mason Environmental Services to remove the UST located adjacent to Building 3444. The removal was initiated as a result of the UST's status as an abandoned tank, as defined by the Massachusetts Board of Fire Prevention Regulations (527 Code of Massachusetts Regulations 9.22).

During removal of the UST, it was noted that the fill pipe was loose and that there was fuel oil staining on the top and sides of the UST at the fill pipe location. The tank was intact when removed, and overburden soils covering it were not affected by fuel oil contamination except at the fill pipe location. Soils around and beneath the UST were screened with a PID according to guidance in Massachusetts Department of Environmental Protection Policy #WSC-400-89, *Jar Headspace Analytical Screening Procedure*. Those soils found to exceed 10 ppm total organic vapor were conveyed to an on-site virgin petroleum-contaminated soil (VPCS) stockpile. The excavation was terminated at a depth of 27 feet, partly because the potential existed for undermining the structure of Building 3444. Approximately 70 cy of VPCS was secured on site as a result of this excavation activity. The VPCS was later disposed of off site by another USCG contractor.

Soil samples collected from the sidewalls and bottom of the UST excavation were field-screened using headspace methods then submitted to a state-certified laboratory for analysis for TPH using EPA Method 418.1. These sidewall soil samples had TPH concentrations ranging from below detection limits to 30 ppm. The sample from the bottom of the hole had a TPH concentration of 180 ppm. All sample results quantified TPH concentrations below the proposed soil target cleanup levels at MMR.

Fill material was brought from another area of MMR to backfill the excavation. Field-screening and subsequent laboratory analysis for TPH revealed that this material was contaminated. The NGB, in consultation with EPA, subsequently excavated and stockpiled this material. Clean backfill material was brought from off base and placed in the excavation.

Discussion of Remedial Objectives

The objectives of the decision document were to describe the history of Study Area FS-26 (USCG), present results of investigations at Study Area FS-26 (USCG), detail the nature and extent of residual soil contamination as determined by analysis of subsurface soil samples from around the former UST location, consider/appraise the absence of groundwater contamination as determined by analysis of groundwater samples from a water table monitoring well located in the former tank pit, and document that No Further Action is appropriate at the FS-26 (USCG) site.



Information is contained in *Remedial Response Action for Building #3444* (Mason Environmental Services, 1992), *Final Preliminary Assessment Report for Study Areas FS-26 and FS-27* (CDM Federal Programs Corp. June 1993), and *Revised Draft Site Inspection Report, Study Areas CS-1, CS-2, CS-6/FS-22, FS-26 and FS-27* (CDM Federal Programs Corp. December 1995).

This decision for No Further Action being required is documented in a report titled *Massachusetts Military Reservation Final Decision Document Study Area US Coast Guard Fuel Spill Site No. 26, July 1997*. Regulatory concurrence with this decision was provided by the following authorities:

Paula Fitzsimmons
Chief, Superfund II Branch
United States, Environmental Protection Agency

18 March 1997

Paul Taurasi
Regional Director
Commonwealth of Massachusetts
Department of Environmental Protection

22 May 1997

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Data collected during the Site Investigation did not indicate that any significant contamination exists at Study Area FS-26 (USCG). Risk evaluations conducted on that data indicate there is no risk to human health or the environment. The site excavation has been filled, and the site remains protective of human health and the environment.



APPENDIX A.16

Site Name: United States Coast Guard Landfill-1 Rubble Landfill

Site Description

Study Area LF-1 (USCG) is an area that was used for disposal of asphalt and debris generated during a runway extension project completed in the 1950s. The study area is located on the south side of Taxiway "D," southwest of Study Area CS-2 (USCG) (Figure 1). The debris was placed on a slope along the southern side of Taxiway "D."

Discussion of Remedial Objectives

The objectives of the decision document was to describe the history of Study area LF-1 (USCG) present results of site characterization investigations at Study Area LF-1 (USCG); present results of the human PRE; and explain why No Further Action is appropriate for this site.

A No Further Action decision was presented in *Installation Restoration Program Decision Document Study Area LF-1 (USCG) Massachusetts Military Reservation, Cape Cod, MA; Final December 1995*. Regulatory concurrence with this decision was provided by the following authorities:

Mary Jane O'Donnell
Acting chief, Superfund II Branch,
United States Environmental Protection Agency, Region 1

29 September 1995

George Crombie
Regional Director, South East Region
Commonwealth of Massachusetts
Department of Environmental Protection

4 December 1995

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

In 1988 and 1989, decision documents were written that included Study Area LF-1 (USCG). In both documents, the lack of apparent sources of hazardous subset construction debris was cited as the reason for No Further Action at this area. At the request of EPA and Massachusetts Department of Environmental Protection (MADEP), a groundwater monitoring well was installed downgradient of the landfill to confirm that groundwater quality had not been impacted. Results of the groundwater analysis indicate that there has been minimal impact, if any, to groundwater. The source of chloromethane and methylene chloride, if not laboratory artifacts, is unknown; however, each was present in only one sampling round at 1 to 2 µg/L. These concentrations are well below health-based Hazard Equivalent Concentration (HECs) and drinking water standards.



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On the basis of the decision documents, there is no evidence of significant environmental contamination at the USCG Former Rubble/Debris Landfill (i.e., Study Area LF-1 [USCG]) posing an unacceptable threat to human health or the environment.



APPENDIX A.17

Site Name: United States Coast Guard Landfill-2 Rubble Landfill

Site Description

Study Area USCG LF-2, located north of the present Base Exchange Store (BX) service station (see Figure 1), is where concrete blocks were dumped. A site study was done at this location in 1986 by an architectural engineering firm. Sections of asphalt and concrete were found at the study area. In addition, the area was determined to be low lying with poor drainage, making it unsuitable as a building site. No evidence of hazardous waste disposal was found.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was concurred by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

There is no evidence of disposal of hazardous waste at this study area; therefore, no potential for contamination or contaminant migration exists. The site remains protective of human health and the environment.



APPENDIX A.18

Site Name: United States Coast Guard Landfill-3 Rubble Landfill

Site Description

Study Area USCG LF-3 is located just south of the entrance to the USCG Transmitter Station (see Figure 1). USCG LF-3 is a demolition rubble and debris landfill, which most recently received sand and gravel excavated during construction of a new dispensary building. Since the dispensary building study area was a wooded, nonindustrial area located on high ground, it is likely that the excavated soil was clean and dry. No written or visual evidence of disposal of hazardous wastes exists.

Discussion of Remedial Objectives

On the basis of information collected during the PA study for this area evaluation, including use of the HARM process, this site was recommended for NFA based on the absence of evidence of significant hazardous waste disposal and the nature and age of the study area.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was provided by the following regulatory authorities within this report:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Because there is no evidence of disposal of hazardous wastes, there is no potential for contamination or contaminant migration, and the site remains protective of human health and the environment.



Appendix A.19

Site Name: Veterans Administration Chemical Spill-12 VA Cemetery Roads and Grounds Shop

Site Description

The Veterans Administration (VA) roads and grounds shop maintains the national cemetery of Massachusetts (see Figure 1) and has operated since 1980. All roads and grounds equipment is housed and maintained at the shop location. Currently the majority of pesticides and herbicides used at the cemetery are applied in powder or granular form and do not require mixing. However, those that required mixing with water were prepared on the tarmac. Any overflow from preparation activity was flushed with water. Containers were rinsed and the rinseate is sprayed at the point of application or used as dilutant for subsequent mixing operations, as appropriate.

Vehicle maintenance and washing occurred in three bays within the maintenance building. Floor drains from these bays, as well as from the flammable and toxic materials storage area, discharged to an oil/water separator, from which the water flowed into a leaching pit. All waste petroleum, oil, and lubricants (POL) and petroleum distillate solvent waste were temporarily stored in a 600-gallon UST and were periodically disposed of off base by a DRMO disposal contractor.

No significant spills of waste POL, petroleum distillate solvent waste, herbicides, or pesticides were recorded during the nine-year history of operations at this study area.

The VA maintains the Roads and Grounds Shop, including those operations that pertain to protection of the environment. As with other parts of MMR, the ANG Civil Engineering (CE) Department also has general responsibility for environmental protection on base. Because of the good operating record in this area, little attention has been necessary to upgrade, replace, or refurbish hazardous waste handling practices. However, should such engineering be required in the future, ANG CE would assist the VA in the effort.

Discussion of Remedial Objectives

A preliminary investigation was conducted by E.C. Jordon Co. which included interviews, past and present usage research, record reviews and on-site inspections and are described in a separate PA report (ORNL 1986b). On the basis of this information, including use of the HARM process, it was concluded that no evidence of hazardous waste exists at this area of concern and that No Further Action is necessary.

This decision for No Further Action being required is documented in a report titled *Decision Document for 11 Study Areas, Massachusetts Military Reservation Installation Restoration Program, August 1990*.

Mutual concurrence in the decision for No Further Action was concurred by the following regulatory authorities within this report:



March 1999

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

There is no evidence of past disposal or spills of hazardous wastes at this study area. Therefore, no contamination or contaminant migration exists, and the site remains protective of human health and the environment.



APPENDIX A.20

Site Name: Veterans Administration Landfill-5 VA Cemetery Rubble Landfill

Site Description

LF-5 is located in the vicinity of the Veterans Administration (VA) Cemetery (see Figure 1). It was used as a debris and concrete rubble fill area. No evidence exists, visual or reported, that any hazardous substances have ever been disposed of at this study area.

A preliminary investigation was conducted by E.C. Jordan Co. which included interviews, past and present usage research, record reviews and on-site inspections and are described in a separate PA report (ORNL 1986b). On the basis of this information, it was concluded that no evidence of hazardous waste exists at this area of concern and that No Further Action is necessary. Regulatory concurrence with this decision is provided in a report titled "*Decision Document for 11 Study Areas, MMR Installation Restoration Program, August 1990*" (HAZWRAP). Regulatory concurrence is provided by the following authorities:

Frank Ciavattieri
United States Environmental Protection Agency, Region 1

21 May 1991

Robert Donovan
Commonwealth of Massachusetts
Department of Environmental Protection

11 July 1991

Discussion of Remedial Objectives

The remedial objectives of this site were to

- identify and evaluate past hazardous material disposal on the area of concern and
- determine the presence or absence of hazardous materials at the area of concern.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

There is no evidence that hazardous wastes were disposed of at this location. Therefore, no potential for contamination or contaminant migration exists.



APPENDIX B
Sites Closed Based on a Record of Decision

List of Sites

- B.1 Fuel Spill-12 Source
- B.2 Landfill-1 MMR Main Sanitary Landfill Source
- B.3 United States Coast Guard Chemical Spill-1 Transmitter Site (LTM only)
- B.4 United States Coast Guard Chemical Spill-3 BX Service Station



APPENDIX B.1

Site Name: Fuel Spill-12 Source

Site Description

As shown in Figure 2, AOC FS-12 is located west of Route 130 and north of Snake Pond in the Township of Sandwich. AOC FS-12 is in a wooded area that can be reached from State Route 130 by way of Greenway Road. The abandoned fuel pipeline runs along the north shoulder of Greenway Road, and the leak occurred at or near the unpaved road providing access to artillery range "L."

The nearest public access area is Camp Good News, a youth recreation and camping facility located in the rural setting immediately east of the boundary. Ponds and wetlands are located to the south of AOC FS-12.

AOC FS-12 is the location of a leak in an abandoned fuel pipeline along the base border in the Town of Sandwich. The pipeline carried both jet fuel and aviation gasoline during its use from 1965 to 1973. The leak was reported to have occurred in 1972. The FS-12 source area was subsequently identified as an approximately 11-acre area of contaminated vadose zone soil, groundwater, and floating product.

Since October 1995, AFCEE has removed over 44,580 pounds of contaminants using a remedial process called vapor extraction and air sparging. Contaminant removal has been completed; confirmation testing continues to ensure that the FS-12 source area has been cleaned up.

Discussion of Remedial Objectives

Based on calculations from the risk assessment, the risk values calculated for current/future exposure to groundwater indicate carcinogenic risk for human exposure to the groundwater. Two media, subsurface soil and groundwater, would require immediate attention for cleanup.

Therefore, general Remedial Action Objectives (RAOs) were provided for subsurface soil and the groundwater.

For subsurface soil, the RAOs include (1) preventing direct contact or ingestion of the soil and (2) preventing migration of benzene and ethylene dibromide (EDB) with concentrations that would contribute to groundwater concentrations greater than federal/state MCLs.

For groundwater, the RAOs include preventing the ingestion of water with concentrations of benzene and EDB equal to or in excess of the MCLs.

The remedial action utilized an air sparging/soil venting system to achieve in situ air stripping and biodegradation of petroleum-derived hydrocarbons from subsurface soils in the FS-12 AOC. Compressed air was supplied through 22 air sparging wells and withdrawn from the contaminated soil region by 21 soil venting wells. The wells were positioned to maintain a net negative pressure over this area of influence during operation of the air sparging system,



eliminating the potential for off-site migration of vapors generated as a result of the air sparging system.

Petroleum-derived contaminants in the soil vapor drawn from the venting wells include benzene, toluene, ethylbenzene, and xylene (BTEX). These contaminants were removed by passing the soil vapor through a catalytic oxidation unit. Trace amounts of EDB may also be present. Since EDB is not readily removed by thermal oxidization, effluent from the catalytic oxidation unit then passes through a carbon adsorption unit.

The Remedial Action Work Plan, Addendum No. 2 for Phase 2 discusses in detail the system operating schedule, baseline and operational sampling and analysis requirements, and closure criteria. The decision to deviate from the operational schedule and permanently terminate operation of the system was made by the IRP office, in consultation with regulatory agencies and HAZWRAP after review of monthly performance and monitoring data.

During demobilization, the site was cleared of any articles or features that could pose a threat to human health or the environment.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

This decision document represents the selected removal action for the AOC FS-12 site in MMR on Cape Cod, Massachusetts, developed in accordance with CERCLA as amended and not inconsistent with the NCP.

Conditions at AOC FS-12 meet the NCP criteria for a removal action, which has been completed as planned.

Statement of the Continued Protection of Human Health and the Environment

Actual or potential exposure to hazardous substances or pollutants or contaminants by nearby populations or the food chain: Since the contaminated soils at AOC FS-12 were located approximately 70–90 feet below grade, there are no current threats to human health due to inhalation, ingestion, or dermal contact.

Actual or potential contamination of drinking water supplies: Soils contaminated with fuel-related organic compounds at AOC FS-12 are currently acting as a source of groundwater contamination. The contaminated groundwater plume threatens downgradient recreational ponds, wetlands, and the Town of Sandwich drinking water supply.

Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release: None identified.

Actual or potential exposure to hazardous substances, pollutants, or contaminants by nearby populations or the food chain: Since the contaminated soils at AOC FS-12 were located



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approximately 70–90 feet below grade, exposure of contaminants at the source area to ecological populations or the food chain was not a risk.



APPENDIX B.2

Site Name: Landfill-1 MMR Main Sanitary Landfill Source

Site Description

AOC Main Base Landfill Number 1 (LF-1) Source Area is located on the southern half of MMR and is bounded by Turpentine and Frank Perkins Road to the east and west, and Herbert Road and Connery Avenue to the north and south, respectively (Figure 2).

Discussion of Remedial Objectives

The interim remedial plan, referred to as a preferred alternative, addressed AOC LF-1 Source control and recommends a method of minimizing further contamination from occurring using containment options evaluated during the Focused Feasibility Study (FFS).

The proposed remedy was selected to take action to protect human health and the environment in the short term while additional information is collected to better assess the response of the aquifer and contaminants for remediation efforts. Thus, the selected remedy is an interim remedy. The interim remedy will operate for a minimum of five years, during which time a final remedial action plan for AOC LF-1 Source Area will be developed. A final ROD for AOC LF-1 Source Area will be based on the data collected during the design, operation, and monitoring for the interim remedy and the findings of further characterization of the groundwater downgradient of 1947, 1951, and 1957 cells.

In summary, the interim remedy consists of (1) constructing a landfill cover system on the 1970 Cell, Post-1970 Cell, and Kettle Hole; (2) conducting postclosure maintenance and monitoring of the cover system on these cells for a minimum of 30 years after the completion of the cover; (3) monitoring landfill gas and groundwater quality semiannually and submitting results for regulatory agency review; and (4) NGB and appropriate regulatory agencies reviewing the effectiveness of the AOC LF-1 source interim remedial action every five years.

The interim remedial actions addressed the following response objectives:

- reduced contaminant leaching to groundwater,
- minimized migration of liquids through closed landfill cells, and
- maintain compatibility with the final remedial measures.

In 1993, EPA approved and MADEP concurred with the *Record of Decision Interim Remedial Action, Main Base Landfill (AOC LF-1) Source Area Operable Unit, Final January 1993*. The following regulatory authorities concurred with the course of action:

Julie Belaga
Regional Administrator
United States Environmental Protection Agency, Region 1

14 January 1993

Daniel S. Greenbaum
Commissioner
Commonwealth of Massachusetts
Department of Environmental Protection

4 January 1993



In EPA's comments dated 30 September 1996 on AFCEE's responses to comments on the July 1996 *Draft AOC LF-1 Main Base Landfill Site Closure Report*, Paul Marchessault, EPA Region 1, found the comments to have been adequately addressed and the report ready to be finalized. Leonard Pinaud, MADEP, approved closure in a letter dated 3 October 1996. The report was finalized in September 1996. As required by the ROD and stipulated in the Postclosure Monitoring Plan, the long-term monitoring program according to the schedule contained in the closure report has now commenced.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Long-term monitoring as well as operation and maintenance activities will continue. The site will be reviewed again in five years.

Statement of the Continued Protection of Human Health and the Environment

The interim remedy has been completed and long-term monitoring has commenced. Postclosure monitoring shows that there are no indications that the integrity of the cells is degrading or that vent gases will require an active management system. Monitoring results indicate that the site remains protective of human health and the environment.



APPENDIX B.3

Site Name: United States Coast Guard Chemical Spill-1 Transmitter Site
Long Term Monitoring (LTM) only

Site Description

The USCG Transmitter Station, designated AOC CS-1 (USCG) is located adjacent to the eastern boundary of MMR (Figure 2).

Discussion of Remedial Objectives

Record of Decision, US Coast Guard Transmitter Station (AOC CS-1 USCG), Final, September 1995 presented the selected No-Action decision for the MMR AOC CS-1 (USCG), chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986. To the extent practicable, the NCP was considered. The decision to select this remedial action is based on the administrative record file for this AOC, which was developed in accordance with Section 113(k) of CERCLA and is available for public review at the information repositories located at (1) the Falmouth Public Library, Falmouth, Massachusetts; (2) the ANG IRP Office at Otis ANG Base, Massachusetts; and (3) the EPA regional office at 90 Canal Street, Boston, Massachusetts.

NGB selected the alternative, which was approved by the following regulatory agencies:

Linda Murphy	29 September 1995
Divisional Director, Waste Management Division	
United States Environmental Protection Agency, Region 1	

George Crombie	29 September 1995
Regional Director	
Commonwealth of Massachusetts	
Department of Environmental Protection	

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

The long term monitoring for this site will continue as planned.

Statement of the Continued Protection of Human Health and the Environment

NGB, acting as executive agent of the USCG, and EPA, with concurrence of the Commonwealth of Massachusetts, have determined that No Action is necessary to address the contamination at AOC CS-1 (USCG). However, groundwater monitoring will be performed at well WW-7 for a period of five years to provide information over time on the levels of VOCs detected in this well and on the sporadic detection of inorganics in groundwater at this AOC. These compounds were detected below state and federal MCLs at this site. The chemicals at this AOC are at concentrations below those considered to present human health or ecological threats.



APPENDIX B.4

Site Name: United States Coast Guard Chemical Spill-3 BX Service Station

Site Description

AOC CS-3 (USCG) occupies approximately 3.5 acres in the south central portion of the MMR, north of Lee Road. The AOC is the former location of an automobile service and gasoline station. Currently, the site is mostly paved with a landscaped grassy area, a gravel parking lot in the eastern portion of the site, and aboveground storage tanks in the west-northwest corner of the site (Figure 2). The site is currently a gasoline station, convenience store, and garden shop known as the "3-in-1." Access to the site is unrestricted. Areas north, east, and west of AOC CS-3 (USCG) are grassy and wooded. The south side of Lee Road includes an open grassy space, several buildings, and a paved parking area. The base hospital is located approximately 1,000 feet northwest of the site.

Available documentation shows that activities may have introduced hazardous substances to the AOC occurred from 1951 to 1979. MOGAS was stored and dispensed, and maintenance operations were performed generating POL wastes. These waste materials were temporarily stored in a UST, Abandoned Tank (AT-23). Grease, oil, and other wastes were reportedly disposed of in a leaching well located at the eastern edge of Building 5202. Unleaded, regular, and premium grades of gasoline are currently dispensed at the fuel island, and waste oil is stored in an AST located behind the 3-in-1.

In 1985, AT-23 was found to be leaking. The UST and associated petroleum-contaminated soils were removed from the site, and a replacement aboveground tank was installed. Testing of the soil and groundwater at AOC CS-3 (USCG) identified that levels of TPH, VOCs, SVOCs, pesticides, and metals were low (below base action levels). However, due to the detection of contaminants in a water supply well downgradient of the AOC across Lee Road, the AOC received a HARM score sufficient to qualify it for further investigation (E.C. Jordan Co., 1986).

In 1994, three former gasoline USTs (Current Product Tanks [CPTs]-40, 41, and 42) were removed and replaced with aboveground tanks as part of the Fuels Upgrade Program in 1994. Approximately 340 cubic yards of contaminated soils was removed from the tank grave, and clean soils were backfilled.

The remedial investigation (RI) recommended "removal of the leaching well and the associated discharge pipes" and "removal of subsurface soils and sediments associated with the leaching well as part of the Drainage Structure Removal Program (DSRP)." Sediment and sludge inside the leaching well were removed during the DSRP, but the leaching well and associated discharge pipes (Orangeburg pipes) were not removed because they are partly buried beneath Building 5202 and removal of them would cause structural damage to the building. The leaching well was filled with concrete. Surface soil and subsurface soil samples collected around the pipes and the pipes' out-fall area showed limited contamination. A stockpile of soils that had been excavated during trenching for the construction of an optical cable line through another AOC on the base, FS-27, is located north of Building 5202. As a precaution, this area was sampled during the RI. Sampling confirmed that the stockpile was not contaminated.



Discussion of Remedial Objectives

The preliminary records review for AOC CS-3 (USCG) was conducted and issued as the SI in 1986. The RI was conducted to characterize the nature and distribution of contaminants at AOC CS-3 (USCG) during 1991.

Several source areas were investigated at AOC CS-3 (USCG), including the embankment (soil pile from FS-27), the former USTs CPT-40, -41, and -42, the former UST CPT-43, the former UST at AT-23, and the abandoned leaching well with Orangeburg pipes. Orangeburg pipes are perforated clay tile pipes that serve as overflow drainage for the leaching well during high-flow episodes. Surface and subsurface soil samples were collected from these locations.

Compounds detected sporadically in surface and subsurface soil samples included TPH, VOCs (i.e., 1,2-dichloromethane, toluene, xylenes, and ketones), SVOCs [i.e., bis-2(ethylhexyl) phthalate, benzo(a)pyrene, benzo(b)fluoranthene], and pesticides [i.e., chlordane, dichlorodiphenyltrichloroethane (DDT)]. Detected concentrations of these compounds and metals were below the MMR soil action levels.

A ground-penetrating radar (GPR) survey was conducted to locate the former UST, CPT-43. This 10,000-gallon tank was reportedly installed in the 1970s for storing diesel fuel. However, there is no record that the tank was ever used. The GPR survey could not locate this tank.

Groundwater was sampled from five borings and six wells in the vicinity of AOC CS-3 (USCG) during the RI field effort in 1993 and 1994. Groundwater samples contained sporadic detections of VOCs (i.e., 1,2-dichloromethane, ethylbenzene, toluene, xylenes, and ketones), SVOCs (i.e., trimethylbenzenes), and metals (i.e., mercury, lead, and thallium). Detected concentrations of these compounds and metals were below the MMR groundwater action levels.

AFCEE, USCG, and EPA, with concurrence of the Commonwealth of Massachusetts, have determined that no remedial action is necessary at AOC CS-3 (USCG). The No Further Action decision is documented in *IRP Record of Decision, AOC CS-3 (USCG) 3-in-1 Store, MMR, Cape Cod, Massachusetts, Final, September 1998*. Regulatory concurrence was provided by the following authorities:

Frank Ciavattieri for
Patricia L. Meaney
Director, Office of Site Remediation and Restoration
US Environmental Protection Agency

30 September 1998



Paul Taurasi, P.E.
Regional Director
Commonwealth of Massachusetts
Department of Environmental Protection

29 September 1998

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

AFCEE and EPA have determined that no further CERCLA action is required at AOC CS-3 (USCG). Because levels of chemicals detected in the soil and groundwater at this AOC do not pose an unacceptable risk to human health or the environment, No Further Action will be undertaken.

Statement of the Continued Protection of Human Health and the Environment

A risk assessment was conducted to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with AOC CS-3 (USCG). The risk assessment was conducted using a phased approach, as described in the MMR IRP Risk Handbook (Automated Sciences Group, Inc., 1994). No chemical levels detected in the soil and groundwater at this site pose an unacceptable risk to human health or the environment.



APPENDIX C
Sites Pending Closure Based on a Site Investigation Leading to No Further Action

List of Sites

C.1	Chemical Spill-1 North Truck Road Motor Pool	C-1
C.2	Chemical Spill-2 East Truck Road Motor Pool	C-3
C.3	Chemical Spill-3 South Truck Road Motor Pool Fuel Spill-23 South Truck Road Fuel Spill	C-6
C.4	Chemical Spill-6 Current ANG Maintenance Shop/Fuel Spill-22 ANG Motor Pool	C-9
C.5	Chemical Spill-8 Organizational Maintenance Shop 22/Fuel Spill-21 Current Product Tank 90	C-11
C.6	Chemical Spill-14 Building 156 Leach Pit	C-14
C.7	Coal Yard-1/Coal Yard-3 Former Army/VA Hospital Coal Yard	C-16
C.8	Fuel Spill-3 Johns Pond Fuel Dump	C-18
C.9	Fuel Spill-14 Range E-3 Fuel Spill	C-21
C.10	Storm Drain-1	C-23
C.11	United States Coast Guard Chemical Spill-2 Hanger 3170 Areas	C-27
C.12	United States Coast Guard Chemical Spill-6 Other Maintenance Shops USCG	C-31
C.13	United States Coast Guard Fuel Spill-2 Hot Asphalt Plant	C-34
C.14	Drainage Structure Removal Program (DSRP) [Basewide]	C-36



APPENDIX C.1

Site Name: Chemical Spill-1 North Truck Road Motor Pool

Site Description

The CS-1 study area was identified in the *Phase I: Records Search, Task 6* (E.C. Jordan Co., December 1986) as a potential source of contamination based on large quantities of waste oils, solvents, antifreeze, battery electrolyte, paint, kerosene, and fuels that were reportedly generated from vehicle maintenance activities. Additionally, metals were reportedly commingled with these wastes. CS-1 includes the former location of four U.S. Army regimental motor pools at blocks 23, 25, 27, and 29 on North Truck Road (refer to Figure 3).

The motor pools, active from 1941 to 1946, originally consisted of 11 vehicle maintenance buildings (VMBs) and 11 gas stations. Abandoned USTs were located at the gas stations. Three gas stations and three VMBs at block 29 were apparently covered over sometime in the 1950s when the U.S. Air Force constructed Taxiway Alpha. It was documented that nine USTs were removed from the site in 1985 and 1986, five USTs may remain in the ground at the east end of CS-1, and five additional USTs at block 29 may remain beneath Taxiway Alpha (ABB-ES, December 1991). Other components of CS-1 include 12 catch basins located within the paved motor pool areas, 11 leaching wells associated with the VMBs, and the fenced perimeter areas that received surface runoff from the pavement.

The Decision Document for Chemical Spill (CS) Site No. 1, Draft, March 1997 summarizes the evaluations of data that conclude No Further Action is needed on defined media at Study Area Chemical Spill Site No. 1 (CS-1), consisting of the former location for U.S. Army regimental motor pools on North Truck Road. AFCEE sent a letter dated 9 November 1998 to MADEP informing them that AFCEE intends to finalize the document in 30 days unless MADEP's comments are received.

The SI recommended No Further Actions for surface and subsurface soils and groundwater, other than the removal of the existing USTs; the VMB foundation slabs, work pits, and associated soils; and the catch basins. These Removal Actions were completed under the DSRP.

Discussion of Remedial Objectives

MMR Final Site Inspection Report, Study Areas CS-1, CS-2, CS-6/FS-22, FS-26, and FS-27, August 1996 presents the summary and recommendations from SIs conducted at the five study areas CS-1, CS-2, CS-6/FS-22, FS-26, and FS-27. The SIs were conducted to provide sufficient data to determine the need for immediate source removal actions, to preliminarily evaluate human and ecological health risks, and to determine the need for further investigations.

The overall objectives of the SI were to determine the presence or absence of soil and groundwater contamination and whether the contamination poses a threat to human health or the environment. The SI must provide sufficient data to determine the need for immediate source removal actions, to prepare a preliminary risk assessment, and to determine the need for further investigation. SI field activities were conducted at CS-1 to satisfy these objectives.

Specific objectives for the field activities at CS-1 were as follows:



- determine the presence or absence of USTs,
- determine the presence or absence of soil contamination associated with the site,
- determine the nature and preliminary extent of soil contamination, and
- determine the presence or absence of groundwater contamination.

Completion of field activities revealed that no contaminants in surface soils exceed Tier I screening values for human health. PAHs in subsurface soils within the catch basins exceed Tier I values for human health, but not Tier II. Therefore, PAHs do not present immediate threats to human health. Chemicals in groundwater do not pose a threat to human health.

The ecological PRE indicates that it is unlikely that a significant number of individuals will be impacted by site-related chemicals or that the site will serve as a significant source of chemicals within the food chain because the site is predominantly impervious (i.e., asphalt and concrete slabs) and supports minimal wildlife habitats. Following removal of the drainage structures, leaching wells, and VMB work pits under the MMR DSRP, contaminants in soils surrounding the paved areas present only a marginal risk to ecological receptors above MMR background conditions.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Analytical data and field observations indicated that the USTs and drainage structures were the primary source of soil contamination at CS-1. All of the drainage structures, VMBs, the two pairs of USTs, and contaminated soils adjacent to these structures were removed during the DSRP and UST removal programs. Chemicals in groundwater do not exceed MCLs or are below MMR background levels, indicating that past site activities have not affected groundwater quality.

Results of the PRE conducted during the SI demonstrate that chemicals in the soils and groundwater at the site do not pose a risk to human health or the environment.



APPENDIX C.2

Site Name: Chemical Spill-2 East Truck Road Motor Pool

Site Description

Study area CS-2 designates the location of three former Army regimental motor pools at blocks 2, 4, and 5 that consisted of three VMBs and three gas stations (Figure 3). Data obtained during a PA and the Sump Investigation Program, identified four primary components of the study area as potential areas of contamination. The four primary components are associated with VMBs, gas stations, pavement/fence perimeter, and catch basins. Two other potential areas of contamination identified are a former oil can storage area at block 4, and the drainage swales at blocks 2 and 4. Field investigations consisted of magnetometer surveys and analysis of soil and groundwater samples.

In 1991, the Sump Investigation Program was conducted at CS-2, in which VMB leaching wells were investigated by collecting liquid and sediment samples from within the structures and soil samples from adjacent to the structures. These samples were found to contain TPH, benzene, toluene, ethyl benzene, xylene, SVOCs, pesticides, lead, and zinc.

In 1993 and 1995, field activities were conducted in support of an SI to determine the presence or absence soil and groundwater contamination. Four components of the study area consisted of the VMBs, gas stations, pavement and fence perimeter, and catch basins. Field investigations included magnetometer surveys and soil and groundwater sample collection and analysis. A PRE was conducted to determine whether the site contaminants pose potential risks to human health and/or ecological receptors.

Results of the SI indicated that organic contaminants were primarily detected in the catch basins and one of the drainage ditches. Subsurface contamination is limited to work pits at the VMBs and the catch basins. VOCs, SVOCs, pesticides, and PCBs were detected in site soils. Inorganic constituents in exceedence of background levels were found in surface and subsurface soils, with concentrations decreasing with depth.

No significant organic or inorganic contamination was detected in groundwater; all concentrations were below MCLs. All filtered groundwater samples had concentrations below background levels.

The PRE indicated no threat to human health due to contaminants in surface soils or groundwater. Surface soil contaminants at the VMB work pit and drainage ditch at block 2 exceeded Tier I values, but not Tier II, for human health. The VMB work pits and associated soil have subsequently been removed as part of the DSRP. The ecological PRE indicated that, although Tier I values were exceeded for some species, the exceedences are attributable to small areas and not to surface soils in general within the CS-2 habitat. Because the site is primarily paved and more suitable habitat is adjacent to the site, the area probably supports minimal wildlife. Therefore, overall ecological risk due to site-related contaminants is considered low at CS-2.



The SI recommended No Further Action for surface and subsurface soils and groundwater other than removal of VMB foundations slabs, work pits and associated soils, and the catch basins. These removal actions were completed under the DSRP.

The draft *Decision Document for Chemical Spill (CS) Site No. 2 Draft, March 1997* prepared by CDM Federal Program Corp has been undergoing regulatory comment and resolution. EPA had one minor comment on 1 September 1998. We are awaiting MADEP's comments. This document summarizes the evaluations of data that conclude No Further Action is needed on defined media at Study Area Chemical Spill Site No. 2 (CS-2), consisting of the former location of three U.S. Army regimental motor pools on East Truck Road.

Discussion of Remedial Objectives

MMR Final Site Inspection Report, Study Areas CS-1, CS-2, CS-6/FS-22, FS-26, and FS-27, August 1996 presents the summary and recommendations from SIs conducted at the five study areas CS-1, CS-2, CS-6/FS-22, FS-26, and FS-27. The SIs were conducted to provide sufficient data to determine the need for immediate source removal actions, to preliminarily evaluate human and ecological health risks, and to determine the need for further investigations.

The overall objectives of the SI were to determine whether a release or a potential for release exists and if the release poses a threat to human health or the environment. The SI must provide sufficient data to determine the need for immediate source Removal Actions, provide a PRA, and determine the need for further investigation. SI field activities were conducted at CS-2 to satisfy those objectives. Specific objectives for field activities at CS-2 were as follows:

- determine the presence or absence of USTs;
- determine the presence or absence of soil contamination associated with target areas of the site (VMBs, former USTs, catch basins, drainage swales, fence lines, etc.);
- determine the nature and preliminary extent of soil contamination; and
- determine the presence or absence of groundwater contamination.

The SI recommended No Further Action for surface and subsurface soils and groundwater other than removal of VBM foundation slabs, work pits, associated soils and catch basins. These Removal Actions were completed under the DSRP.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Analytical data and field observations indicated that all USTs were previously removed and that the drainage structures were the primary source of soil contamination at CS-2. Subsequently, all of the drainage structures, VMBs, and contaminated soils adjacent to these structures were removed during the DSRP removal program. Chemicals in groundwater do not exceed MCLs or



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are below MMR background levels, indicating that past site activities have not affected groundwater quality.

Results of the PRE conducted during the SI demonstrate that chemicals in the soils and groundwater at the site do not pose an unacceptable risk to human health or the environment.



APPENDIX C.3

Site Name: Chemical Spill-3 South Truck Road Motor Pool/USCG Fuel Spill-23 South Truck Road Fuel Spill

Site Description

The South Truck Road Motor Pool (Study Area CS-3) is located along the south-central boundary of MMR (Figure 3). In the past, the U.S. Army (1940 to 1946), the ANG CE Department (1950 to 1973), and the USAF (1955 to 1973) used this site as a motor pool (E.C. Jordan Co., 1986). Study Area CS-3 also was reportedly used as a waste disposal site from 1950 to as late as 1973. The central third of the study area is currently used by the ANG CE Roads and Grounds Department. Buildings in this area had coal-fired furnaces as recently as 10 years ago. Coal bins to supply these buildings also are located in Study Area CS-3.

Oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels were generated at the South Truck Road Motor Pool. Unknown quantities of these wastes were reportedly dumped along the back fence of the study area. Contaminants commonly associated with such wastes include chlorinated solvents (i.e., TCS, PCE, and 1,2-DCE) and fuel-related compounds (i.e., BTEX). Inorganic analytes associated with such wastes are lead (from paint, AVGAS, and MOGAS) and corrosion and engine-wear metals (i.e., iron, chromium, nickel, and zinc) that would be present in waste antifreeze and motor oils. Six MOGAS USTs were decommissioned and removed from behind maintenance buildings at the site. Of the four buildings originally constructed, only two were standing at the time of the field investigations; only Building 968 is still in use, as a vehicle and tool storage area. The building is no longer used for vehicle maintenance.

The South Truck Road Fuel Spill Site (Study Area FS-23) is located northeast of Study Area CS-3. A clean-out valve for an underground 10-inch fuel line, no longer in use, is located at Study Area FS-23. Two underground fuel lines, originating at the Railroad Fuel Pumping Site (Study Area FS-2), were used from 1955 until 1965 to transfer JP-4 and AVGAS to aboveground tanks at the Petroleum Fuels Storage Area. In 1965, an estimated 1,000 gallons of JP-4 leaked onto the ground from one of the clean-out valves (E.C. Jordan Co., 1986). This spill is defined as Study Area FS-23.

In addition to other study-area features, Study Area CS-3 also was identified as containing seven underground drainage structures. Three of these seven structures were investigated in 1991 during Phase I of the sump investigation program. Four additional underground drainage structures were identified at Study Area CS-3 during preparation of the engineering evaluation/cost estimate. The structures were abandoned and/or removed in 1996.

Discussion of Remedial Objectives

The PA of MMR identified the South Truck Road Motor Pool and the leak in the fuel line at South Truck Road as areas of past potential releases of hazardous substances. At that time, the designations of Study Areas CS-3 and FS-23, respectively, were assigned. Because of their physical proximity and similar histories of releases of fuel products, Study Areas CS-3 and FS-23 were studied together during three field investigation programs.



As part of the PA conducted for the IRP at MMR, Study Area CS-3, the South Truck Road Motor Pool, and Study Area FS-23, the South Truck Road Fuel Spill, 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 SI field investigation programs and a drainage structure removal program conducted between 1988 and 1992.

The objective of these investigations were to identify the presence or absence of hazardous wastes at the study area and to evaluate risk, if any. Upon completion of the site characterization efforts, the recommendation was made to remove the study areas from further consideration within the IRP. This recommendation was reviewed by EPA. As a result of the SI investigations and a subsequent evaluation of human health and ecological risks, only minimal contamination of the sites was identified, and unacceptable levels of risk are not anticipated. Therefore, both study areas are recommended for No Further Action via the decision document.

MMR Decision Document Study Areas CS-3/FS-23 South Truck Road Motor Pool/South Truck Road Fuel Spill, Draft, May 1997 summarizes the results from investigations, presents the human health and ecological risk assessments of these areas, and recommends NFA for these study areas. This document is currently pending regulatory approval.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

On the basis of the findings contained in the draft Decision Document, May 1997 there is no evidence of significant environmental contamination or of human-health or ecological risks at Study Areas CS-3/FS-23. The decision has been made to remove these study areas from further consideration in the IRP process. Explicitly exempted from this decision are the three leaching wells at Study Area CS-3.

Statement of the Continued Protection of Human Health and the Environment

Soil and groundwater characterization efforts detected minimal contamination at Study area CS-3/FS-23. Although some soil contaminants were detected at concentrations exceeding the more conservative Tier I HEC, unacceptable risks are not present for a more realistic nonresidential future land use. Tier I HEC and MCL exceedances were reported for BEHP. However, BEHP was detected in only one of two sampling events in one well. Because of the frequency of BEHP detection, the low concentration (11 µg/L) detected, and the potential that it was introduced in the laboratory, it is not expected to result in unacceptable human-health risks. In addition, if BEHP is actually present in groundwater, the concentration will decrease over time as a result of natural degradation processes.

Results of the human-health and ecological risk assessments suggest that unacceptable levels of risk are not anticipated. Results of confirmation sample analyses from the DSRP construction indicate that soil contamination, associated with six drainage structures at the study areas, was removed. At one structure that was abandoned in place, a foundation is present above the structure, which will prevent human exposure to the soil and any potential contaminants in the soil that surrounds the structure. In addition, the presence of the foundation will prevent the



percolation of surface water through the soil profile, which will minimize any potential contaminant migration.

Therefore, it is concluded that Study Areas CS-3/FS-23 does not require additional characterization or remediation efforts and that No Further Action within the IRP is appropriate. The site remains protective of human health and the environment.



APPENDIX C.4

Site Name: Chemical Spill-6 Current ANG Maintenance Shop/Fuel Spill-22 ANG Motor Pool

Site Description

Study Area CS-6/FS-22 was identified in the IRP record searches (E. C. Jordan Co., 1986). It includes Building 754 and the surrounding area, which have been used as a VMB since 1967 (Figure 3). Study Area CS-6 structures and site features that may have functioned as waste discharge points include an abandoned oil/water separator (OWS) (designated 26CDXX1), a companion leaching well (designated 26CDXX2), and paved areas draining to the drainage structures or property perimeters. Study Area FS-22 is a drainage ditch located south of, and adjacent to, CS-6, into which a 4,500-gallon fuel spill discharged in 1984. The discharge was contained within the drainage ditch. All free product was removed from the ditch, and visibly contaminated soil was excavated. Potential discharged materials that may be associated with CS-6 include waste solvents, oils, and fuel.

OWS 26CDXX1 and leaching well 26CDXX2 were investigated under Phase I of the DSRP. Details of those investigations are contained in the *Sump Removal Action Program, Phase I Sump Investigation Program, Work Completion Report* (ABB-ES, 1992).

Structure 26CDXX1 is a former oil interceptor that was removed from use in 1989. Currently, 26CDXX1 is used as a diversion manhole for piping connecting floor drains in Building 754 to drainage structure 26CDXX3 (an OWS discharging to the sanitary sewer). Structure 26CDXX1 is of typical interceptor construction. Structure 26CDXX1 is a relatively watertight structure with piping inlets and outlets. It was designed to contain oils and discharge water to a drainage ditch. Consequently, neither free-phase or dissolved-phase fuels, oils, or solvents discharged through the sides or bottom of the structure. Discharges through the discharge point were found to contain only minimal relic petroleum compounds. Groundwater downgradient of the structure did not contain organic or inorganic compounds exceeding risk criteria.

Results of that investigation are reported in *Sump Removal Action Program, Phase I Sump Investigation Program, Work Completion Report* (ABB-ES, 1992). Sediments from the OWS and leaching well contained VOCs, SVOCs, pesticides/PCBs, and metals. Soil samples collected with Geoprobos® at both drainage structures did not contain quantifiable levels of VOCs, SVOCs, or PCBs. Pesticides and TPHs were detected.

Structure 26CDXX2 is a Type II leaching well; it was removed from service in 1989. Before removal from service, it functioned in line with 26CDXX1; 26CDXX2 did allow leaching of contents. Wells downgradient of the structure do not contain organic or inorganic compounds exceeding risk criteria.

An SI was conducted at CS-6/FS-22 between November 1992 and March 1993. Details of that SI are presented in the final SI report (CDM Federal, 1996). In that inspection, the study area was differentiated into four source areas: a stained soil area located at the southeast perimeter of CS-6 and associated with the discharge point of OWS 26CDXX1, the drainage ditch south of the CS-6 perimeter (FS-22), a stained soil area adjacent to the northeastern perimeter of CS-26, and the perimeter of CS-6 defined by the edge of pavement and the fence line. The SI included surface



soil sampling and subsurface soil sampling at the source areas and groundwater sampling at upgradient and downgradient locations. Collected samples were analyzed for VOCs, SVOCs, metals, and pesticide/PCBs using Level D quality assurance/quality control (Contract Laboratory Program) CLP methods. The samples were analyzed for TPH at Levels B and C using Method 418.1. A PRE was performed for the entire CS-6/FS-22 AOC, and a PRA was completed for FS-22 and the southeast stained soil area of CS-6.

MMR Decision Document Chemical Spill-6/Fuel Spill-22, Draft Final, July 1998 was issued by the AFCEE under the IRP at MMR. The decision for No Further Action pertains to soils at the Study Area for Chemical Spill Site No. 6, also designated as Fuel Spill Site No. 22 (CS-6/FS-22), that contain concentrations of regulated compounds and to the groundwater underlying Study Area CS-6/FS-22.

This decision document summarizes evaluations of data that conclude No Further Action is needed on defined media at Study Area CS-6/FS-22.

Discussion of Remedial Objectives

The overall remedial objectives were to determine whether a release or a potential for release exists and if the release poses a threat to human health or the environment. The SI must provide sufficient data to determine the need for immediate source removal actions, provide a PRA, and determine the need for further investigation. SI field activities were conducted at CS-6/FS-22 to satisfy those objectives. Specific objectives for field activities at the site were as follows:

- determine the nature and preliminary extent of soil contamination in the drainage ditch and associated area of stained soil,
- assess the potential for groundwater contamination based on the vertical extent of subsurface contamination, and
- determine the presence or absence of groundwater contamination.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Analytical data provide evidence that a petroleum product, or products, and pesticides were released at CS-6/FS-22. Data suggest that the fuel spill that discharged into the drainage ditch was adequately remediated. Data also indicate that though there have been pesticides used at this site, no excessive concentrations of pesticides exist.

Results of the PRE and PRA demonstrate that residuals of the spill and other chemicals present at the site do not constitute a risk to human health or the environment.



APPENDIX C.5

Site Name: Chemical Spill – 8; Organizational Maintenance Shop 22/ Fuel Spill - 21 Current Product Tank 90

Site Description

Study Areas CS-8/FS-21 are located next to each other along the south central MMR boundary (Figure 3). Because of this geographical proximity, Study Areas CS-8/FS-21 were combined for purposes of SI field activities.

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. Since 1970, all vehicle maintenance wastes except used battery electrolyte have been disposed of off site through either the Defense Reutilization or Marketing Office (DRMO) or 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. It is estimated that 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 (E.C. Jordan Co., 1989a). The quantities actually disposed of on site are unknown. Currently, wastes generated at Study Area CS-8 are drummed, sent to Building 4600 for storage, and transported to the Fort Devens, Massachusetts, DRMO for disposal.

Study Area FS-21, southwest of the Vehicle Repair Shop, is the former location of CPT No. 90, a 5,000-gallon MOGAS UST installed in 1954. The 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 tank of the same capacity, installed west of the Vehicle Repair Shop (Pesce and Berube, 1990). At the time of the removal of CPT No. 90, the associated piping and gasoline pump island were removed, and the area was regraded.

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 tanks are not available.

Potential contaminants identified in the PA were waste solvents and oils, battery electrolyte, and MOGAS (the primary constituents of MOGAS are hydrocarbons). Based on findings of the PA, Study Areas CS-8/FS-21 were recommended for SI studies.

SI activities at Study Areas CS-8/FS-21 focused on potential contamination from historical operations discussed in the PA. After completion of test pits, soil borings, and monitoring wells in 1987, CPT No. 90 and the diesel-fuel UST were removed and replaced in 1988. No contamination was noted in the surrounding soil, which is consistent with the interpretation of investigation results at those two areas. There is no reason to suspect contamination resulting from the replacement tanks; therefore, investigative activities were not directed at them.



SI efforts at Study Areas 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.

Results of the Tier I human health PRE for future residential use showed HEC exceedences for Aroclor-1260, arsenic, and beryllium in surface soil. However, arsenic and beryllium concentrations are below the MMR surface-soil background. Tier II human health HEC exceedences were not identified in surface soil.

The Tier I human health PRE showed HEC exceedences for benzo(b)/(k)fluoranthene, arsenic, beryllium, iron, and manganese in groundwater. In addition, aluminum, iron, and manganese in groundwater exceeded SMCLs. Only the maximum detected manganese concentration exceeded the Tier II HEC for groundwater. All other detected manganese concentrations in groundwater were 10 times less than the maximum concentration and less than the Tier II HEC. The single outlier may have resulted from sample turbidity.

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.

Based on evaluation of available soil and groundwater data, it is concluded that exposure to site media does not present unacceptable risks to potential human or ecological receptors.

IRP Decision Document Study Areas CS-8/FS-21 Operational Motor Pool, OMS-22/Current Product Tank No. 90, Preliminary Final, May 1997 was prepared to support a No Further Action decision at Study Area CS-8 (Operational Motor Pool, OMS-22) and adjoining Study Area FS-21 (Current Product Tank No. 90) at MMR. Currently this document is undergoing regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Results of Tier I of the human health PRE for future residential use showed HEC exceedences for Aroclor-1260, arsenic, and beryllium in surface soil. However, arsenic and beryllium



concentrations are below the MMR surface-soil background. Tier II human health HEC exceedences were not identified in surface soil.

The Tier I human health PRE showed HEC exceedences for benzo(b)/(k)fluoranthene, arsenic, beryllium, iron, and manganese in groundwater. In addition, aluminum, iron, and manganese in groundwater exceed SMCLs. Only the maximum detected groundwater manganese concentration exceeded the Tier II HEC for groundwater. All other detected manganese concentrations in groundwater were 10 times less than the maximum concentration and less than the Tier II HEC. The single outlier may have resulted from sample turbidity.

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. Therefore, this site remains protective of human health and the environment.



APPENDIX C.6

Site Name: Chemical Spill – 14; Building 156 Leach Pit**Site Description**

Study Area CS-14 includes a vapor degreasing leaching pit located at Building 156 and an abandoned OWS, as shown in Figure 3. In addition, a sand/gasoline trap and a new OWS, installed in 1989, are present at the study area. From 1955 to 1969, the leaching pit received discharge from a room that housed a vaporization degreaser. The exact quantities of wastes drained into the leaching pit are unknown. The leaching pit reportedly consists of perforated pipe to facilitate liquid infiltration of the soil. Since 1969, the types of wastes that were once discharged to the leaching pit have been retained and stored in 55-gallon-capacity drums for disposal elsewhere (E.C. Jordan Co., 1986). Unrecoverable solvents are discharged via the gasoline trap and new oil/water separator. During the SI, a majority of the study area was found to be paved and nearly level. Small grassy areas were present along the building perimeters and no staining was observed in these areas.

Study Area CS-14 was evaluated as part of the Task 6 records search, which identified the vapor degreaser-leaching pit as a potential area of contamination. This leaching pit is located off the western side of Building 156, adjacent to a room containing a single scupper drain that leads to the leaching pit. Trichloroethene (TCE) and tetrachloroethene (PCE) were reportedly used as solvents in this room to remove cosmoline, a petroleum-based rust inhibitor, from new engines and engine parts. Most of these solvents were reportedly recycled and reused; however, a portion was probably discharged to the scupper drain and connecting leaching pit (E.C. Jordan Co., 1986).

Two other underground structures are located in the area of the leaching pit: a sand and gasoline trap, located approximately 25 feet southwest of the leaching pit, and an abandoned oil/water separator, near Hangar 158. Although these structures were not originally identified as features of Study Area CS-14 and were not documented as sources of potential contamination in the records search, they represent possible sources of contaminant release to the environment.

SI field activities included soil-gas sampling and analysis, and soil and groundwater sampling from each of three monitoring wells installed at the study area. The soil samples were collected for field and laboratory analysis from one monitoring well boring (i.e., MW-3).

Soil results show one VOC (i.e., methylene chloride) detected in one sample near the leaching pit. Soil-gas analysis results indicated potential concentrations of the VOCs PCE and TCE in soil below a grassed area near the leaching pit. In addition, both PCE and TCE were detected in groundwater at concentrations below drinking water MCLs.

PREs were conducted for potential human health receptors. Results of these PREs, coupled with the current land use and limited areas showing contaminants, suggest no unacceptable risks to human health. Due to the limited suitable habitat and industrial setting, use by potential ecological receptors is unlikely.

Drainage structures at Study Area CS-14 that were investigated as part of the DSRP include the



leaching pit and diversion manholes associated with the abandoned OWS at Hangar 158. Phase I of the DSRP included subsurface-soil sampling in the area of these structures. Field analytical results showed halogenated and aromatic VOCs, SVOCs, pesticides, and inorganics in subsurface soils around the structures. The Phase I DSRP results were used in the DSRP engineering evaluation/cost analysis, which recommended removal of the leaching pit at Study Area CS-14. However, the leaching pit was not found after test trench excavations were performed in 1996.

MMR Study Area CS-14 Decision Document, Draft, May 1997 summarizes the SI activities and results for Study Area CS-14 and provides the rationale for the No Further Action decision. This document is currently undergoing regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Results of the human health PRE conducted on the limited soil data set available for Study Area CS-14 indicate no HEC exceedences. A data gap identified at the study area was the condition of soil below the leaching pit. This data gap was addressed as part of the DSRP. Test trenches excavated at the leaching-pit location showed no evidence for the presence of this structure.

The maximum detected concentration of beryllium and manganese in groundwater exceeded human health Tier I HECs; however, these concentrations are considered consistent with background levels present at MMR. The fate of groundwater TCE and PCE detected in study-area wells should be evaluated as part of the Southeast Region Groundwater Operable Unit RI.

Tier I of the human health PRE showed that the concentration of the one analyte detected in soil was below the human health HEC. The maximum detected concentrations of beryllium and manganese in groundwater exceeded human health Tier I HECs but are consistent with background groundwater concentrations present at MMR.



APPENDIX C.7

Site Name: Coal Yard – 1 / Coal Yard – 3; Former Army / VA Hospital Coal Yard

Site Description

Study Area CY-1 is a former U.S. Army coal storage area that was used from 1940 to 1957. Study Area CY-1 is located east of Turpentine Road and south of Lee Road in an area now occupied by the base theater, barracks, and athletic fields (Figure 3). When Study Area CY-1 was in use, coal was unloaded from railroad cars and stockpiled along two rail sidings on the western side of the rail spur leading to the quartermaster area north of Lee Road. Coal was transported from Study Area CY-1 to individual power plants. Base drawings and aerial photographs indicate that the coal piles may have extended over 1,000 feet along the sidings. A coal weigh station and smaller coal piles were located on a rail siding east of the rail spur. The rail sidings at Study Area CY-1 have been removed, along with all visible evidence of former coal storage activities. The area is now vegetated, paved, and occupied by buildings.

In 1962, water supply Well B, located approximately 600 feet east of the weigh station and 1,200 feet east of the main coal storage area was closed because of contamination by phenolic compounds. Because phenols can be constituents of coal pile leachate; the source of these compounds in Well B, as stated in the records search, was originally suspected to be Study Area CY-1 (Stahl et al., 1984; and E.C. Jordan Co., 1986). However, groundwater flow direction in this region of MMR is south-southwesterly, as interpreted from water level measurements taken in May 1986, May 1987, and May 1990. Therefore, water supply Well B is not believed to be located downgradient of Study Area CY-1. Analysis of two rounds of water samples from Well B collected in 1986 did not detect VOCs, SVOCs, or inorganics of concern (E.C. Jordan Co., 1987).

Study Area CY-3 is located at the site of the former Veterans Administration (VA) hospital steam plant at the corner of East Hospital and West Hospital roads. The steam plant was in operation from 1945 to 1972. Coal was stored on an unbermed, paved pad before transfer to hopper bins. Coal ash was stored temporarily in an on-site pit.

Coal, coal ash, and soot are not classified as hazardous wastes; however, these materials contain organic and inorganic constituents that could potentially leach into infiltrating precipitation and runoff (Anderson and Youngstrom, 1976; Fendinger et al., 1989; Stahl et al., 1984; Olem et al., 1983; and Wachter and Blackwood, 1978). Because of the potential for contamination and risk to human health and the environment resulting from coal and coal ash, four coal storage areas were included in the IRP inventory of potential hazardous waste sites on MMR (E.C. Jordan Co., 1986). The records search also identified potential site contaminants including iron, sulfur, and other inorganics; phenols; and PAHs, which are components of coal.

Soil samples were not collected at Study Area CY-1 and Study Area CY-3 to evaluate the presence of contamination. However, based on a comparison of site histories, impact to soil at Study Area CY-1 is expected to be similar to that detected at Study Area CY-2 and attributed to coal storage activity. TCL SVOCs were not detected above contract-required quantitation limits (CRQLs) in surface soils at Study Area CY-2. Several TAL inorganics associated with coal leachate were also detected. Subsurface soils at Study Area CY-2 were found not to be



contaminated with TCL VOCs. No evidence of SVOC contamination in subsurface soils was attributed to coal storage activities. Several TAL inorganics were detected at low concentrations.

MMR Decision Document, Study Areas CY-1 and CY-3, Final, October 1998 was prepared to support a No Further Action decision at Coal Storage Yard No. 1 (Study Area CY-1) and Coal Storage Yard No. 3 (Study Area CY-3) at MMR. The report was prepared as part of the U.S. Department of Defense (DOD) IRP to assess the nature and extent of contamination associated with previous site operations at MMR.

The site is currently pending regulatory concurrence for a No Further Action (NFA) decision. The public comment period for the CY-1/CY-3 Decision Document has been put on hold pending the sampling at CY-4 (one of the 6 AOCs). The sampling will probably commence in late January 1999 with results due in February 1999.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

On the basis of findings at Study Area CY-2 and AOC CY-4, there is no evidence or reason to conclude that historical coal or ash storage activities at Study Areas CY-1 and CY-3 have caused significant environment contamination or pose a threat to human health or the environment. In addition, no contamination was detected in groundwater at Study Area CY-1 and the site continues to be protective of human health and the environment.



APPENDIX C.8

Site Name: Fuel Spill – 3; Johns Pond Fuel Dump

Site Description

Study Area FS-3 is located on Back Road just south of the MMR boundary, upgradient of the Briarwood residential area and Johns Pond (Figure 3). The AOC consists of a 1,500-foot section of Back Road and the area within approximately 50-feet of either side of the road. Between 1955 and 1962, fuel or fuel-contaminated water was drained onto the study area by refueler trucks to facilitate maintenance. During this period of activity, an average of three trucks per week used the site for this purpose. It is estimated that during each event, a refueler truck drained approximately 40 gallons of fluid onto the road (E.C. Jordan Co., 1986).

A PA conducted in 1986 as part of the MMR Phase I IRP studies identified Study Area FS-3 as a potential area of past uncontrolled releases of hazardous substances. The PA identified components of JP-4 jet fuel and aviation gasoline as potential contaminants. Because of the physical characteristics of the sandy soil at MMR, potential exists for at least limited contaminant migration of the soluble fuel components.

Results of SI characterization tasks at Study Area FS-3 show no soil or groundwater contamination of concern from historic disposal of fuels or fuel-contaminated water. Soil gas and boring investigations did not detect fuel-related contaminants in subsurface soils. Concentrations of TAL inorganics exceeding MMR background by less than one order of magnitude do not provide evidence of fuel-related contamination. Toluene in one subsurface soil sample may be from current use of the site as a public road and/or fuel dumping associated with activities at Study Area FS-3. Other VOCs, SVOCs, and pesticides/PCBs were not detected in the soil, and data do not indicate the presence of contaminant source areas in soil at the site.

Data to evaluate Study Area FS-3 were obtained primarily from the Task 2-3B SI (E.C. Jordan Co., 1990a). SI activities included a soil gas survey, soil boring and monitoring well installation, and collection and analysis of soil and groundwater samples.

Further action or response at Study Area FS-3 appears unwarranted. Assessment of soil data, which are consistent with MMR background concentrations, shows an absence of contaminant source areas and inorganic concentrations exceeding hazard equivalent concentrations. The VOC toluene was detected in one soil sample, but its presence may be related to current site use as a public road. Other VOCs and target organic compounds were not detected. Fuel-related compounds were not detected in groundwater, with the exception of thallium, which exceeded its maximum contaminant level (MCL) by less than 1 µg/L. Inorganic concentrations in groundwater were below MCL concentrations.

The human health PRE identified three inorganic analytes that may pose a risk to current and future construction workers. However, each of these analytes was detected at concentrations consistent with MMR background concentrations. Similarly, four inorganic analytes detected in groundwater were identified as potentially causing a risk above regulatory guidelines, but like the soil data, detected concentrations were consistent with (i.e., within one-half order of



magnitude) or below the MMR background. The only inorganic chemical detected in groundwater was trichloroethene, which was detected at a concentration equal to the MCL (5 µg/L) in one sample. It is suspected that this compound is from an upgradient source and not from the FS-3 Study Area.

The ecological PRE completed for the Study Area FS-3 yielded results similar to the human health PRE as only two inorganic analytes were found to potentially pose a risk above regulatory guidelines to modeled ecological receptors. The maximum concentration of both analytes, cyanide and chromium, were only slightly above MMR background. Further, because of attempts to collect samples from only the most suspect areas and the conservative approach outlined in the Risk Assessment Handbook, the PRE for Study Area FS-3 likely overestimates potential sitewide risks.

MMR Decision Document, Study Area FS-3, Johns Pond Road Fuel Dump Site, Final, May 1997 was prepared to support a No Further Action decision at Study Area FS-3, the Johns Pond Road Fuel Dump Site, at MMR. The report was prepared as part of the DOD IRP to assess the nature and distribution of contamination at MMR and to recommend appropriate remedial action. The report is currently undergoing regulatory review.

Based on the findings of the SI, this decision document concludes that exposure to site media does not present unacceptable threats to human health or the environment and recommends No Further Action under the IRP and the Comprehensive Environmental Response, Compensation, and Liability Act at Study Area FS-3.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Human health and ecological PREs were conducted for Study Area FS-3 in accordance with the RAH (ASG, 1994). In the Tier I human health PRE, based on worst-case future residential exposure, the HECs for arsenic, beryllium, and iron were exceeded for surface soils. For groundwater exposure, the HEC for TCE was exceeded, although the detected concentration did not exceed the federal and state MCLs (5 µg/L). Maximum groundwater concentrations of arsenic and beryllium exceeded Tier I HECs, but were less than MMR background concentrations. Manganese at 288 µg/L exceeded both the Tier I HEC and the SMCL of 50 µg/L. Thallium, detected at a maximum concentration of 2.3 µg/L, slightly exceeded MMR background (1.5 µg/L) and the MCL of 2.0 µg/L. Only iron exceeded the human health Tier I HEC for subsurface soils. None of the contaminants present in surface and subsurface soils or



groundwater exceeded human health Tier II criteria, which indicates that immediate response or remediation to protect human health is not necessary.

The ecological PRE showed HEC exceedences for chromium and cyanide in surface soil. Calculation of HI values for site ecological receptors showed the HI exceeded 10 for one of three target receptors: the HI for the cardinal was 20. Essentially 100 percent of the HI was contributed by cyanide, which was detected in only one of six surface soil samples.

Additional action or response appears unwarranted at Study Area FS-3. In the case of the human health PRE, the maximum measured soil concentrations of arsenic, iron, and beryllium at Study Area FS-3 are consistent with (i.e., only slightly above) maximum MMR background concentrations. In groundwater, although HECs for TCE, arsenic, beryllium, manganese, and thallium are exceeded, only thallium exceeds an MCL, but by less than 1 µg/L. Manganese exceeds its SMCL. No Tier II human health HECs, based on current land use, are exceeded.

Soil analyte concentrations approximating background and inorganic groundwater concentrations at or below MCLs further argue against proceeding to an RI/PS because site media already meet these presumptive clean-up levels.



APPENDIX C.9

Site Name: Fuel Spill – 14; Range E-3 Fuel Spill

Site Description

FS-14 is located in Range E-3, on the north side of the Range Maneuver and Impact Area on the northern portion of MMR (Figure 3). Access to the site is currently restricted to military personnel. The areas surrounding FS-14 are moderately wooded, and the site itself is open with little vegetation. Site topography is gently sloping, with elevation increasing to the northeast. The site is intermittently used by Army Reserve troops on maneuvers.

FS-14 is the site of a MOGAS fuel spill of approximately 500 gallons that occurred in 1985. MOGAS accidentally discharged to the ground surface when a fuel hose became unhooked from a fueling truck belonging to the 39th Engineering Battalion. The spill occurred during exercises in the remote area, after the battalion set up camp for the night. Fuel from the truck, which contained pods of both MOGAS and diesel, was dispensed via a gravity feed hose, which when not in use was raised and hooked to the truck. At some time during the night, the hose became unhooked, and the contents of the MOGAS fuel pod discharged to the ground surface. The following morning when the release was discovered, the MMR facility manager was contacted, and the area was excavated to a depth of approximately 17-feet bgs. At the bottom of the excavation, readings of less than 50 parts per million (ppm) were detected on a Photovac Photo-Ionization Detector (PID), and excavation sidewall readings were 0 ppm. As excavation was being performed, 20 to 30 cubic yards of contaminated soil was transported off site by truck. While the truck traveled to and from the off-site disposal area, soils were temporarily stockpiled adjacent to the northwest corner of the excavation on polyethylene sheeting (Leblanc, 1985).

During the PA, Study Area FS-14 was ranked using the HARM system and received a HARM score of 55. HARM considers factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The HARM system is designed to prioritize sites at an installation and indicate the relative need for follow-up action. FS-14 was recommended for limited Phase II studies.

Data used to evaluate Study Area FS-14 were obtained primarily from a 1996 SI. SI activities included the collection and analyses of surface soil samples, soil boring samples and the installation and sampling of four monitoring wells.

No significant contamination was detected in surface soil, subsurface soil, or groundwater samples obtained at FS-14. The only analyte detected above regulatory levels was thallium (2.6 µg/L) in groundwater from well MW-4, which exceeded state and federal regulatory limits of 2 µg/L but was below the MMR maximum background level of 15 µg/L. Thallium is not a component of MOGAS.

At FS-14, the following analytes exceeded MMR RAH Tier I human health criteria: arsenic and beryllium in surface soils; arsenic in subsurface soils; and thallium and alpha-chlordane in groundwater. None of the constituents detected exceeded Tier II human health criteria.



Based in the findings of the SI, this decision document concludes that exposure to site media does not present unacceptable threats to human health or the environment and recommends No Further Action under the IRP.

MMR Draft Decision Document Fuel Spill 14 (FS-14), Draft, May 1997 was prepared to support a No Further Action decision. This document is currently undergoing regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

No significant contamination was detected in surface soil, subsurface soil, or groundwater samples. The only analyte detected above regulatory levels was thallium, which exceeded state and federal regulatory limits but was below the MMR maximum background levels. In addition, thallium is not related to the reported fuel release at this site.

The following analytes exceeded Tier I human health criteria: arsenic and beryllium in surface soils; arsenic in subsurface soils; and thallium and alpha-chlordane in groundwater. None of the constituents detected exceeded Tier II human health criteria or MMR background levels.

The Tier I ecological PRE for FS-14 indicated that the HIs were within the acceptable range for all mammals with the exception of the shrew. The HIs for the shrew exceeded the inorganic criteria of 10. All organic HIs for mammals were less than 1. It should be noted that the background HI is also in the unacceptable range, and that subtracting the background HI from the total HI for the shrew would yield an HI of 9.03, which is within the acceptable range. The primary risk drivers for the inorganics are arsenic, chromium, and zinc, none of which are related to the fuel spill. For birds, all the organic HIs were less than 1, and all the inorganic HIs were less than 10, indicating that all risks were within the acceptable range.



APPENDIX C.10

Site Name: Storm Drain – 1; Storm Drain Disposal Site

Site Description

Study Area SD-1 is a 2,300-foot-long drainage ditch beginning at the southern side of South Outer Road at the southern MMR boundary (Figure 3). The ditch channel runs southwest approximately 1,500 feet before making a 90-degree turn to the southeast. Completed in 1960, the channel is constructed of riprap blocks loosely fitted together and is up to 200 feet wide and 6 to 10 feet deep. The channel occupies approximately 10 acres and is dry, open, and gravelly where riprap is not present.

The Study Area SD-1 channel conveys storm water received at its northern end from one 48-inch and two 72-inch storm drains southward off base to the abandoned cranberry bogs located north of Ashumet Pond. The 48-inch line drains portions of the parade ground. The two 72-inch lines convey overflow storm water from the AOC SD-5 drainage swale, which receives storm water from the western portion of the former EC-121 parking and fueling area, the alert hangar area, and portions of the southern runway area. From 1955 to 1970, contaminants resulting from routine maintenance activities at the EC-121 parking area, as well as accidental fuel spills, may have washed into the AOC SD-5 drainage swale and impoundment (E.C. Jordan Co., 1986). The AOC SD-5 drainage swale is not lined, and most of the water entering it likely infiltrated through the highly permeable sands. However, during major storm events, the 72-inch storm drains convey overflow from AOC SD-5 to Study Area SD-1. The quantities of surface water and the concentrations of contaminants, if any, flowing from AOC SD-5 into the storm sewer to Study Area SD-1 are unknown.

The PA conducted in 1986, as part of the MMR Phase I IRP studies, identified Study Area SD-1 as a potential area of past uncontrolled releases of hazardous substances. The PA identified potential study-area contaminants, including halogenated solvents (i.e., 1,1,1-trichloroethane [TCA], TCE, methylene chloride, and PCE), nonhalogenated solvents (i.e., methyl isobutyl ketone and toluene), C-6 to C-24 alkanes, oil and grease, and lead (E.C. Jordan Co., 1986). According to the PA, historic discharges of contaminants to the Study Area SD-1 storm drainage system may have affected soils within the drainage area, surface water at the abandoned cranberry bog or Ashumet Pond, and groundwater off base and downgradient of the study area.

Study Area SD-1 was ranked using the HARM. The HARM process considers factors such as site and waste characteristics, potential for contaminant migration, and waste management practices to prioritize sites for Further Action. Using this process, Study Area SD-1 was assigned a score of 64.2 and classified as a Priority 1 site. Based on study findings, the PA recommended that SI studies be conducted at Study Area SD-1.

Study Area SD-1 was evaluated as a potential source of soil and groundwater contamination rather than a current conduit of contamination from upstream locations. Although contamination still exists in areas upstream of Study Area SD-1 (notably AOC SD-5), the majority of these sources are no longer operationally active. The eastern and western aquafarms, Nondestructive Inspection Laboratory, corrosion control shop, and aircraft maintenance hangars are abandoned, and current disposal of contaminants in the areas upstream of Study Area SD-1 appears to be



nonexistent. The contaminants observed upstream of Study Area SD-1 are unlikely to result in contaminated surface waters that would affect Study Area SD-1, for two reasons. First, the majority of surface water flow quickly permeates the sandy soils and never reaches Study Area SD-1. Second, contamination observed in upstream areas on base is restricted to relatively small surficial areas; any deeper contamination will not affect surface-water flows. Sumps and other structures, which are below ground, are unlikely to affect surface waters that might flow through the storm drains to Study Area SD-1.

Future uncontrolled releases of hazardous materials upstream of Study Area SD-1 that might affect surface water flowing through the drainage ditch are not anticipated.

Based on investigations conducted at Study Area SD-1, there are no apparent source areas affecting groundwater quality. The low concentrations of chlorinated compounds detected in the soil gas survey of the drainage ditch do not indicate the existence of contaminant source areas at Study Area SD-1. In subsurface soils at MW-1 and MW-2, laboratory analyses did not detect VOCs and SVOCs. Several inorganic compounds were detected in subsurface soils at concentrations greater than CRDLs, but within established MMR background concentration ranges.

PAHs, pesticides, and inorganics were detected in sediment samples collected from the Study Area SD-1 drainage ditch. DDT and dieldrin were detected sporadically and at low concentrations (0.02 and 0.05 mg/kg, respectively). The widespread use of dieldrin to control Japanese beetles on the base in 1963 may account for its presence in the drainage ditch sediment (E.C. Jordan Co., 1986). Concentrations of inorganic compounds are generally similar to MMR background concentrations for soils and typically within the range of concentrations common for soils in the eastern United States. Inorganic concentrations in several of the sediment samples exceed MMR background concentrations; however, sediments in the drainage ditch may have a higher organic carbon content (and a greater affinity for inorganics) than typical MMR sands; therefore, this comparison may be misleading.

The compounds toluene and PCE were detected at low concentrations (i.e., 1 µg/L each) in one groundwater sample. Other site-related organic compounds were detected. Calcium and sodium were the only inorganics detected above CRDLs in groundwater samples.

Study Area SD-1 was included in the Tasks 2-3A, 2-3B, and 2-3C SIs at MMR (E.C. Jordan Co., 1989, 1990a, and 1990b). SI activities included a soil gas survey, drilling of two soil borings and installation of two monitoring wells, field screening of soil samples, collection of groundwater samples, and laboratory analysis of soil and groundwater samples. Analytical results showed no significant contamination in subsurface soils or groundwater. Chemical source areas were not found through the soil gas, soil boring, or groundwater sampling investigations.

Results of Tier I of the human health PRE, based on maximum concentrations and a future residential use scenario, showed HEC exceedences for PAHs and inorganics in surface soil collected from the drainage channel. There were no exceedences of human health Tier II HECs for the more likely current land use scenario.



At SD-1, PRA calculations were completed for the specific chemicals exceeding the Tier I HECs to further quantify potential future risks. Risks calculated using average and maximum concentrations show total cancer risks for both residential and nonresidential risk scenarios do not exceed the USEPA target risk range of 1×10^{-6} to 1×10^{-4} . The total cancer risk for the resident (future use) scenario does slightly exceed the Massachusetts risk criteria of 1×10^{-5} . However, because of its physical layout, Study Area SD-1 is not likely to be used for future residential use.

The ecological PRE showed that maximum surface soil concentrations exceeded for two of three evaluated receptors. The hazard index for the cardinal exceeded 10 for inorganics. In groundwater, the concentration of beryllium exceeded its Tier I human health HEC but was less than the MMR background concentration, drinking water MCL, and the Tier II HEC.

MMR Decision Document, Study Area SD-1 Runway/Aircraft Maintenance Storm Drain Ditch, Final, for Public Comment, September 1997 was prepared to support a No Further Action decision at the Runway/Aircraft Maintenance Storm Drainage Ditch, Study Area SD-1, at the MMR. The report was prepared as part of the DOD IRP to assess the nature and distribution of contamination at MMR.

On the basis of these findings, there is no evidence of significant environmental contamination at Study Area SD-1 that poses an unacceptable threat to human health or the environment. The decision has been made to remove Study Area SD-1 from further consideration in the IRP process. The decision by USEPA not to pursue further action at this site under the CECLA is not a determination that no action is warranted under other regulations and statutes.

The site is currently awaiting DEP signature since sent out 30 July 1998.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Results of Tier I of the human health PRE for maximum exposure concentrations and a future residential use scenario showed HEC exceedences for benzo(a,h)anthracene, BAP, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, beryllium, and manganese in surface soil, and beryllium in groundwater. Although the concentrations of arsenic and beryllium in surface soil exceeded their human health Tier I HECs, they were less than MMR background concentrations.



At SD-1, PRA calculations were completed for the specific chemicals exceeding the Tier I HECs to further quantify potential future risks. Risks calculated using average and maximum concentrations show total cancer risks for both residential and nonresidential risk scenarios do not exceed the USEPA target risk range of 1×10^{-6} to 1×10^{-4} . The total cancer risk for the resident (future use) scenario does slightly exceed the Massachusetts risk criteria of 1×10^{-5} . However, because of its physical layout, Study Area SD-1 is not likely to be used for future residential use.

In groundwater, the concentration of beryllium exceeded its human health HEC but was less than the MMR background concentration. No analyte concentrations in groundwater exceeded MCLs. No exceedences of human health Tier II HECs for current land use were identified for surface soil or groundwater.

Tiers I and II of the ecological PRE showed that maximum surface soil concentrations of benzoic acid, chromium, cyanide, and zinc exceeded HECs. For the white-footed mouse, the organic HI was less than 1, and the inorganic HI was 10. HIs for the cardinal exceeded 1 for organics and 10 for inorganics. There were no exceedences for the red fox. The organic HI for plants exceeded 1 because of PAHs, but the inorganic HI for plants was less than 1.

The conservative nature of the PRE approach may overestimate potential risks. The Study Area SD-1 drainage channel is likely to remain a storm water control structure and not be developed for future residential use. Further, because of the riprap lining along much of the channel, potential human contact is reduced for both future (Tier I) and current (Tier II) evaluations, compared to more accessible soils. Ecological risks may also be overestimated. The channel does not provide adequate forage or cover for ecological receptors, other than an occasional small rodent, and it is unlikely that all evaluated ecological receptors will make significant use of the study area.

The PAHs and pesticides are expected to behave similarly if left in place at Study Area SD-1. Because of their low water solubility, high octanol-water partition coefficients, and low vapor pressures, they are expected to remain sorbed to soil, with little tendency to migrate to groundwater or to volatilize. Their ultimate fate will probably be to slowly biodegrade.

Based on evaluation of available soil and groundwater data and expected contaminant fate, it is concluded that site media will not be a source of groundwater contamination and that exposure to site media does not present unacceptable risks to potential human or ecological receptors.



APPENDIX C.11

Site Name: Chemical Spill – 2 (United States Coast Guard); Hanger 3170 Areas

Site Description

Study Area CS-2 (USCG) is located on the MMR on Cape Cod, Massachusetts (Figure 3). It is at the end of Herbert Road, north of the northwest-southeast runway. This study area was identified initially in the Task 7 records search preliminary assessment of MMR as part of the IRP (E.C. Jordan Co., 1986b). The IRP is a program at military facilities to identify, evaluate, and remediate waste disposal and spill sites that may have become contaminated through historical practices.

Study Area CS-2 (USCG) consists of USCG Air Station Hangars 3170 and 3172, an Auto Hobby Shop housed in Building 3161, the Ground Support Shop housed in Building 3162, and support facilities housed in Buildings 3163 and 3164. Areas of the study area east and south of Hangar 3172 are restricted, accessible to authorized personnel only.

Since 1970, Hangars 3170 and 3172 have been used for maintenance activities on fixed- and rotary-wing USCG aircraft. Floor drains from the maintenance area located in the northern end of Hangar 3170 empty into a dry well and, subsequently, a leach field located off the northeastern corner of the hangar. Other floor drains in Hangar 3170 discharge liquids through an OWS to a rubber-lined open pond and ultimately to a drainage ditch located on the southern side of the hangar. Floor drains from Hangar 3172 are connected to a second OWS, which reportedly discharges to the sanitary sewer system. Overflow from the Hangar 3172 OWS also is discharged to the rubber-lined pond.

From 1970 to 1976, aircraft were washed on the tarmac outside Hangar 3170 using petroleum distillate degreasing agents. These agents were washed into open storm drainage ditches off the eastern side of Hangar 3170, onto grassy areas on the southern edges of the hangar tarmac. Additionally, from 1972 until 1976, waste POL, degreasing solvents, and other waste solvents were used for dust control purposes on unpaved areas in the vicinity of Hangar 3170 (E.C. Jordan Co., 1986b).

The Ground Support Shop (i.e., Building 3162) is used for maintenance of gasoline- and diesel-powered vehicles. Wastes generated include waste oil and solvents that are reportedly stored in a bowser until pickup for off-MMR disposal. From 1970 until at least 1981, battery acid waste generated at Building 3162 was reportedly dumped into a dry well. The dry well north of Hangar 3170 is the only one known to be in this study area.

A second potential AOC at Study Area CS-2 (USCG) is a former refueler-truck parking and barrel storage area located approximately 450 feet south of Hangar 3170, on the southern side of Taxiway "D" (see Figure 4). In the past, aircraft-refueler trucks were reportedly parked on the western side of this rectangular paved area and 55-gallon barrels were stored on the eastern side. Fuel may have spilled from the refueler trucks when parked in this area. There were no documented spills in the barrel storage area. The contents, if any, and the current disposition of the barrels is unknown. During Phase 3 of the SI, staining was not visible around the edge of the pavement that constitutes the former barrel storage area.



Study Area CS-2 (USCG) was evaluated as part of the Task 7 records search, which indicated that contaminants may have been released to the environment as a result of maintenance activities, spills, and disposal practices. Chemicals potentially used at the study area include petroleum, oil, and lubricants (POL), solvents, and battery acid (E.C. Jordan, Co., 1986b). From 1970 until 1981, lead-acid battery electrolyte was potentially discharged to two OWSs located near or within Buildings 3170 and 3172. From 1978 to 1981, nickel-cadmium battery electrolyte, spilled solvents, and oils were potentially discharged to the OWSs (E.C. Jordan, Co., 1986b).

Consequently, an SI was conducted at the study area. The SI was conducted during three phases, Phases 1 through 3, between 1989 and 1993; a Phase 4 supplemental sampling program also was conducted. The purpose of the supplemental sampling was to address regulatory concerns on the presence or absence of contaminants below the "rubber-lined pond" and the drainage course leading from it. Data collected during the supplemental sampling program showed contaminants at concentrations below levels of regulatory concern in soils below the rubber-lined pond and in the drainage course. In addition, as part of the DSRP, a leaching well and associated dry-well structure were removed at Study Area CS-2 (USCG). Results of the SI indicate minor releases of fuel, PCBs, and inorganic compounds at the study area. However, based on the PRE performed for this study area, unacceptable human health risks are not expected from exposures to soil and groundwater.

Organic and inorganic chemicals detected in soils are below Tier I HECs for human health at Study Area CS-2 (USCG). In groundwater, one SVOC and two inorganic compounds exceeded the Tier I human health HECs. However, because of the low frequency of detection above background, no history of use at the study area, and conservatism of the HEC, No Further Action for human health exposures is warranted.

In surface soil, concentrations of several PAHs and inorganics exceeded the lowest Tiers I and II HECs for ecological receptors. However, these exceedences were generally confined to the drainage course adjacent to Hangar 3170. Because of the overall lack of habitat and level of human activity near Hangar 3170, little exposure to PAHs at levels exceeding HECs is likely. Therefore, No Further Action for ecological exposures is warranted.

As part of the DSRP at MMR, a leaching well and dry-well-type leaching structure near Hangar 3170 were removed in April 1996, achieving clean closure.

MMR Decision Document, Study Area CS-2 (USCG), Draft, May 1997 was prepared to support a No Further Action decision for Study Area CS-2 (USCG). It was prepared as part of the DOD IRP to assess the nature and distribution of contamination associated with previous site operations at MMR. This decision document summarizes SI activities and results for Study Area CS-2 (USCG), and provides the rationale for the No Further Action decision and is currently under regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.



Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

Based on results of the SI and the current use of the Study Area CS-2 (USCG), human and ecological exposure to contaminant concentrations of regulatory concern are unlikely. Specifically, the following conclusions are made:

- No Further Action is warranted based on the sporadic detection of BEHP in groundwater. BEHP exceeded the Tier I groundwater HEC and the most conservative MCL (see Table 5-4); however, the detection of BEHP is likely the result of sample collection and/or laboratory handling based on its frequency and no history of prior use at the study area.
- No Further Action is warranted for the presence of beryllium in groundwater due to its infrequent detection (i.e., two of 10 samples) above MMR background concentrations. Beryllium exceeded the human health groundwater HEC in only one monitoring well during Phase 1 and another during Phase 2.
- No Further Action is warranted for the detections of manganese above MMR background concentrations. Manganese exceeded Tier I human health HECs in groundwater samples from monitoring wells MW-1, MW-3, MW-4, and MW-S; however, the detected concentrations of manganese may be the result of surface-water infiltration into these flush-mounted wells or local geologic variations. Although elevated concentrations of manganese have been associated with degradation of fuels, groundwater sample results have not indicated the presence of fuel-related compounds. Manganese was detected at background levels in two wells at the study area, and there is no history of its use at the study area. In addition, the HEC is conservative, likely resulting in an overestimation of risk.
- No Further Action is warranted on soils including those in the drainage course adjacent to Hangar 3170. Concentrations of several PAHs and inorganics exceeded the lowest Tiers I and II soil HECs for ecological receptors. However, these exceedences were generally confined to areas adjacent to Hangar 3170. Based on the overall lack of habitat and level of human activity near Hangar 3170, little exposure to these analytes by ecological receptors is likely. Hangar 3170 is used on a regular basis for maintenance and storage of search-and-rescue helicopters and airplanes. Based on the lack of significant vegetative cover, and level of human activity, use by ecological receptors is likely to be minimal.
- Chemical concentrations in both soil and groundwater collected during the supplemental sampling of 1995 were generally either below Tier I HECs or within concentration ranges similar to the Phases 1,2, and 3 samples. As a result, no additional human health or ecological risks are interpreted to be present based on the Phase 4 supplemental investigation findings. Dieldrin exceeded the Tier I HEC for human health in the sample from MW-6, but



the concentrations reported in the original sample and its duplicate were equal to or only slightly (i.e., 0.02 µg/L) above the detection limit and flagged as estimated.

Based on findings of the SI including the PRE, and use of the study area, there is no evidence of significant environmental contamination at Study Area CS-2 (USCG) posing an unacceptable threat to human health or the environment.



APPENDIX C.12

Site Name: United States Coast Guard Chemical Spill – 6; Other Maintenance Shops USCG

Site Description

Study Area CS-6 (USCG) is located on MMR on Cape Cod, Massachusetts (Figure 3). The study area is situated in the south-central portion of MMR.

Study Area CS-6 (USCG) consists of the USCG Building 5215, which houses maintenance shops. During the SI, a gentle slope of the ground surface from north to south was observed. East of Building 5215, beyond the paved access road, the ground surface is grassed with woods beyond.

This study area was identified initially in the Task 7 Records Search preliminary assessment of MMR as part of the IRP (E.C. Jordan Co., 1986b). The IRP is a program at military facilities to identify, evaluate, and remediate waste disposal and spill sites that may have become contaminated through historical practices.

According to the Task 7 Records Search, the USCG has used Building 5215 since 1973. Before 1973, the ANG used the building as a Noncommissioned Officers Club. The USCG operates maintenance shops in Building 5215, including the electrical shop, utility shop, roads and grounds shop, and “Do It Now” shop. Wastes generated at the shops included oils, hydraulic fluid, and cleaning solvents. According to the records search, the roads and grounds shop generates the largest quantity of wastes. Spills and disposal of unknown quantities of these wastes onto the ground and into the street reportedly have occurred (E.C. Jordan Co., 1986b). Some of these spills may have traveled into the storm drain system, which ultimately discharges to Edmunds Pond, located approximately 1 mile southwest of the study area.

An SI was conducted at the study area. Results of the SI indicate minor releases of fuel at the study area; however, risks to human and ecological receptors caused by the presence of fuel-related compounds appear to be minimal.

During Phases I and II of the SI conducted in 1989 through 1991, one 2,000-gallon UST (CPT-45) and two aboveground storage tanks (ASTs) (CPT-46 and CPT-47) were noted at the site. CPT-45 and CPT-46 contained MOGAS; CPT-47 contained diesel fuel. Until 1991, CPT-45 (MOGAS) was located south of Building 5215, CPT-47 (diesel) was located near the current location of the northernmost shed, and CPT-46 (MOGAS) was located near the current position of the middle shed (Figure 3). No records have been found that indicate that these tanks have leaked.

During the Confirmation Study in February 1993 for the Priority 2 and 3 Study Areas, one diesel AST (CPT-47) was observed in the northernmost of the three sheds located east of Building 5215, a location different than that recorded in December 1989. The MOGAS AST (CPT-46) was not present.

A November 1994 site walkover and a discussion with USCG personnel revealed several changes had occurred relative to the UST and ASTs since 1993. The 2,000-gallon UST has been



removed in accordance with Massachusetts Department of Environmental Protection (MADEP) regulations and the closure report is in Appendix B. Two 300-gallon ASTs, one diesel and one new MOGAS, are now located in the northernmost shed (see Figure 4). It is not clear if the diesel AST is new or if the existing AST was relocated.

PREs were conducted for human health and ecological receptors. Results of these PREs, coupled with the current land use and limited areas showing contaminants, suggest no unacceptable risks to human health or ecological receptors.

This decision document summarizes the SI activities and results for Study Area CS-6 (USCG) and provides the rationale for the No Further Action decision.

MMR IRP Decision Document, Study Area CS-6 (USCG), Draft, February 1995 was prepared to support a No Further Action decision for the USCG Building 5215 (i.e., Study Area CS-6 [USCG]). This document is currently undergoing regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

No Further Action is required.

Statement of the Continued Protection of Human Health and the Environment

The soil data collected during the SI at Study Area CS-6 (USCG) generally indicate nondetects, but minor MOGAS fuel and/or diesel spills may have occurred in the vicinity of the ASTs.

Except for beryllium and BAP in surface soils, no risk to human health was identified in the preliminary health risk evaluation. The beryllium concentration of 0.66 mg/kg exceeded the HEC of 0.149 mg/kg; however, the maximum MMR background concentration for beryllium is 0.65 mg/kg, which also exceeds the HEC. Based on this, a large percentage of the risk can be attributed to background levels, not Study Area CS-6 (USCG) site activities. The BAP concentration of 0.4 mg/kg exceeded the HEC of 0.0877 mg/kg. This detection of BAP is at TP-4, which was excavated adjacent to a roadway. Motor vehicle exhaust is a common source of this compound. The sporadic nature (i.e., one detection) and relatively low concentration of BAP detected, coupled with conservative assumptions in the PRE (e.g., residential use of the land), indicate that current study area conditions do not present an unacceptable risk to humans.

Except for BEHP and zinc, which exceeded the screening values for the upland sandpiper in surface soils, no risks to ecological receptors were identified in the preliminary ecological risk evaluation. The BEHP concentration of 37 mg/kg exceeded the HEC of 0.812 mg/kg. However, BEHP was detected in one of four samples, and is a common sampling and laboratory contaminant (USEPA, 1991). Furthermore, BEHP is not typically associated with fuels. Based



on this information, BEHP is not likely a site-related contaminant. The zinc concentration of 67 mg/kg exceeded the HEC of 3.98 mg/kg. Zinc was detected in only one of two samples analyzed and, although it exceeded the HEC, the average MMR background concentration for zinc exceeds the upland sandpiper HEC by four times. A significant portion of the risk associated with the zinc concentration can be linked to background concentrations, not site activities.

The sediment data indicate that there is potential risk for ecological receptors in Edmunds Pond. However, due to the extensive storm-drain network associated with this discharge point, no direct correlation can be made to Study Area CS-6 (USCG) activities.

TPHs were detected at elevated levels in two samples, TP-1 and TP-3. According to the test pit logs, both these samples were collected from unvegetated, localized, black-stained soil occurring between the surface and 1 foot bgs adjacent to former AST locations (see Appendix D). However, recent site activities (see Subsection 2.6), which included moving the ASTs and reworking the soil in the vicinity of the ASTs, have likely dispersed the soil containing the TPH. The subsurface soil sample collected during the drilling of MW-1 does not indicate that fuel-related compounds have migrated vertically in the soil column. Also, the groundwater samples collected from MW-1 indicate that groundwater quality has not been affected by fuel-related compounds.

Based on the soil and groundwater data and the previous records search, there is no evidence of significant environmental contamination at the USCG Building 5215 (i.e., Study Area CS-6 [USCG]) posing an unacceptable threat to human health or the environment.



APPENDIX C.13

Site Name: United States Coast Guard Fuel Spill – 2; Hot Asphalt Plant

Site Description

Study Area FS-2 (USCG) is part of MMR on Cape Cod, Massachusetts (Figure 3). The study area is located adjacent to Turpentine Road and is reportedly the former location of a hot-mix asphalt plant. This study area was identified during the Task 7 records search preliminary assessment of MMR as part of the IRP (E.C. Jordan Co., 1986b).

Study Area FS-2 (USCG) is a lightly wooded half-acre area located adjacent to Turpentine Road. The study area is approximately 2 to 5 feet below the elevation of Turpentine Road. The center of the study area is nearly level with steep slopes, approximately 15 percent, along the western and southern perimeters.

According to the Task 7 records search, the study area is the former location of an asphalt plant that was operated between 1941 and 1943 by Roach Construction Company, a private contractor (E.C. Jordan Co., 1986b). The precise location of the asphalt plant is not known; however, information in the records search indicated it was within several hundred feet of Turpentine Road in the area across from Buildings 3458 and T-3454.

As part of the asphalt-plant operations, trucks used for transporting bituminous asphalt were washed in the plant area (E.C. Jordan Co., 1986b). The truck beds were reportedly washed with kerosene or diesel fuel to remove excess asphalt, and the fuel and resultant waste were reportedly spilled on the ground. It is estimated that up to 8,000 gallons of fuel was spilled as a result of these operations.

PREs were conducted for human health and ecological receptors in the SI (ABB-ES, 1993). Results of these PREs, coupled with the current land use and limited areas showing contaminants, do not suggest risks above regulatory guidelines to human health or ecological receptors. Based on a qualitative evaluation of the supplemental sampling data (ABB-ES, 1995), the PRE for Study Area FS-2 (USCG) did not need to be revised to include these additional data.

MMR Decision Document, Study Area FS-2 (USCG), Draft, March 1997 was prepared to support a No Further Action decision for Study Area FS-2 (USCG). It summarizes SI activities and results for Study Area FS-2 (USCG), and provides the rationale for a No Further Action decision. This document is currently undergoing regulatory review.

Discussion of Remedial Objectives

The remedial objectives for this site were to characterize site conditions and determine the presence or absence of hazardous materials, as well as evaluate risk and determine what actions, if any, need to be taken.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations



No Further Action is required.

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Based on these conclusions, particularly the fact that a majority of PRE PAH exceedences were from samples in an isolated 0.5-foot layer of an asphaltlike substance and no CPCs (i.e., PAHs and inorganic analytes) were observed in groundwater, there is no evidence of significant environmental contamination at Study Area FS-2 (USCG) posing an unacceptable threat to human health and the environment.



APPENDIX C.14

Site Name: Drainage Structure Removal Program (DSRP) (Basewide)

Site Description

MMR is listed on the 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. Due to the nature of this program, the DSRP cannot be shown as a site in Figure 3.

The MMR has been characterized through past and ongoing site investigation activities. The DSRP design addresses specific drainage structure removal activities and not AOC or operable unit remedial activities. As a result, this report focuses on the MMR drainage structures themselves and not specific AOCs. Specific AOCs and the DSRP impacts on these AOCs will be resolved through documents issued for the specific sites. Table 2-1 lists the specific drainage structures addressed within the DSRP and the specific AOCs, if any, with which they are associated.

The National Guard Bureau (NGB) evaluated the drainage structure 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.

Previous work associated with the DSRP includes the Phase I investigation activities performed by ABB Environmental Services, Inc. (ABB-ES, 1992). Phase I consisted of a sampling and analysis program to evaluate, through the collection and analysis of structure contents and samples from surrounding soils, approximately 100 drainage structures as potential contaminant sources. Phase I also included a drainage structure discovery component; an additional 161 structures were identified.

This work was followed by a Phase II Drainage Structure Investigation Program. Under this program, Metcalf & Eddy, Inc. (M&E, 1993) investigated the contents, surrounding soils, and the groundwater below 15 Priority 1 drainage structures. Because of the operational and contaminant similarities of a large number of drainage structures at the MMR, the NGB decided to evaluate these structures in a single basewide program. In the M&E study, soil contamination was found near some of the drainage structures, which included VOCs, SVOCs, pesticides, PCBs, TPHs, and inorganics.



A number of the drainage structures were investigated to determine the nature of the structure contents (i.e., liquids and sludge), and the quality of the surrounding soils and groundwater. As a result, the NGB determined that the drainage structures at MMR may be contributing, or may have the potential to contribute, contaminants into environmental media. Because of this potential, and due to existing regulation in the Commonwealth of Massachusetts under the Underground Injection Control Program pursuant to 310 Code of Massachusetts Regulations (CMR) 27.00, the NGB determined that these drainage structures should be removed. Subsequently, M&E prepared an Engineering Evaluation/Cost Analysis (EE/CA) (M&E, 1994) and final design package (M&E, 1995). These documents addressed remedial objectives, developed remedial alternatives, provided analysis of alternatives, and developed a detailed remedial design package for the DSRP.

A total of 216 drainage structures were addressed under the DSRP. Twenty-four drainage structures not listed in the design specifications were discovered in the field and removed during project execution. A total of 40 drainage structures were removed or "delisted" from DSRP activities as a result of conditions encountered in the field.

The DSRP generated approximately 15,000 tons of excavated soils, which after characterization, segregation, and blending with concrete demolition debris generated 17,477 tons of state regulated OABF emulsified road base paving material. Other wasted streams generated included 45 tons of federally regulated soil; 62,239 gallons of oily waste and waste water; and 46 55-gallon drums of federally regulated sludge and sludgy soils. The waste materials were characterized, manifested, transported, and disposed in compliance with design specifications and regulatory guidance by appropriately licensed haulers and facilities.

Discussion of Remedial Objectives

The DSRP design was based on removal and characterization of drainage structure contents and limited excavation of surrounding soils; segregation of these media based on chemical analysis; and disposal of the media relative to nonregulated, state-regulated, or federally regulated criteria presented in the design. A majority of the characterized waste was anticipated to be classified as state-regulated and encapsulated through the use of an on-site asphalt-batching facility (OABF) with the resulting material used as road base paving material within the MMR. These action requirements as well as documentation of the outcome are discussed further in the *Final Drainage Structure Removal Program Specifications*, July 1995 prepared by Metcalf and Eddy, as well as the approved Jacobs Engineering *Drainage Structure Removal Program*, January 1996.

1. Removal of approximately 185 existing drainage structures, including the removal of liquid, sludge, and sediment contents within the structures.
2. Demolition of existing VMB reinforced-concrete slabs and foundations and associated structures including disposal of all debris.
3. Testing of soil, liquid, sludge, and sediment for contamination based on guidelines contained in the contract documents.



4. Stockpiling and treatment or disposal of excavated drainage structure debris and surrounding soil to be based on test results in accordance with provisions set forth in the contract documents.
5. Unless otherwise specified, backfill all excavations with nonregulated excavated material, as defined in the contract documents, or ordinary borrow from an on-site source.
6. Restoration of disturbed areas to their original condition.
7. The contractor's registered land surveyor shall establish coordinates for location of all removed drainage structures based on the Massachusetts State Plane Coordinate System.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

1. A report titled *MMR Drainage Structure Removal Program Remedial Action Summary Report, Draft December 1997* has been submitted outlining construction activities, drainage structure removal efforts, operation of on-site asphalt batching facility, testing efforts and documenting removal actions.
2. The various sections of the *MMR Drainage Structure Removal Program (DSRP) Remedial Action Summary Report, Draft, December 1997*, together with the appendices and referenced contractor documentation, provide supporting data for the remediation project.
3. Acquire regulatory approval/certification that removal action is complete.
4. In a few cases, there needs to be additional follow on work at a few sump locations under Deep Soil Groundwater Program.

Statement of the Continued Protection of Human Health and the Environment

The analytical data presented in the reference "Closure Reports" has been provided, edited, and validated by JEG and/or third parties (i.e., Massachusetts Licensed Site Professionals).

The DSRP is considered an AOC in the context of being a removal program for basewide sources of potential contamination. The program reduced potential exposures to human receptors and the environment. Potential risks of residual contaminants left behind are addressed in each individual sump area close out report.



APPENDIX D
Sites in Progress Pending Records of Decision Requiring No Further Action

List of Sites

D.1	Fuel Spill-17 Former WWII Motor Pool/Fuel Transfer Point	D-1
D2	Fuel Spill-19 Former MOGAS Fuel Storage & Point	D-4



APPENDIX D.1

Site Name: Fuel Spill-17 Former WWII Motor Pool/Fuel Transfer Point

Site Description

Area of concern (AOC) FS-17 is located just west of the former main base landfill, LF-1, in the south central portion of Massachusetts Military Reservation (MMR). The study area covers approximately 1 acre (Figure 4). At the time of the 1993/1994 remedial investigation (RI) field program, prominent features of the paved and gravel-covered study area included two building foundations (Buildings 3692 and 3694), an intact structure (Building 3693), and a pump island for both gasoline and diesel fuel. A pitch pine and scrub oak forest that serves as wildlife habitat borders the study area on three sides. At the time of the RI, the main concerns associated with this AOC were the disposal of wastes associated with vehicle repair activities that took place in former Building 3694, as well as possible leaks from two former underground storage tanks (USTs), referred to as current product tanks (CPTs) 104 and 105. CPT-104 contained leaded motor gasoline and CPT-105 contained diesel fuel at the time of a 1986 investigation; no other portions of the facility were active. Subsequent to the completion of the 1993/1994 RI, the USTs, the fuel pump island, and associated Building 3693 were removed as part of the MMR Fuel Upgrade Program.

Discussion of Remedial Objectives

A site investigation (SI) was undertaken in 1990 to assess the presence or absence of contamination resulting from fuel spills or leaks associated with the fuel pump island, USTs, and vehicle repair bays. The SI included a soil-gas survey, a limited soil investigation, sampling of a leaching well and French drain, and a limited groundwater investigation. The soil-gas survey showed the presence of chlorinated hydrocarbons adjacent to former Buildings 3692 and 3694. Test pits excavated in the vicinity of the French drain showed the presence of polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs), chlorinated solvents, and inorganics. Sediment samples collected from the leaching well showed high concentrations of fuel constituents. Groundwater samples collected from a well installed downgradient of these structures showed detectable concentrations of chlorinated hydrocarbons during the SI Phase 1, but not during Phase 2 in 1991. Based on SI activities, it was recommended that additional soil and groundwater data be collected to evaluate possible leaks and spills associated with waste sources, as well as past and present fueling activities. Subsequent to the completion of the 1993/1994 RI, the leaching well, the French drain, the dry well and foundations of former Buildings 3692 and 3694 (along with the vehicle repair bays) were removed as part of the MMR Drainage Structure Removal Program (DSRP).

The RI for AOC FS-17 was designed to further characterize potential soil and groundwater contamination, evaluate site hydrogeology, and determine potential risks to human health and the environment posed by contaminants in the study area. The 1993/1994 RI field program for AOC FS-17 included Geoprobe soil sampling in 13 locations, surface soil sampling at five locations, advancing three test borings, installing five new groundwater monitoring wells, and collecting seven groundwater samples. The hydrogeologic investigation included measuring depths to static groundwater and performing in situ hydraulic conductivity tests on all existing and newly installed wells. Soil and groundwater samples were analyzed by an on-site mobile laboratory and



an off-site fixed-base laboratory. The mobile laboratory was used to provide real-time screening data to select soil samples for off-site laboratory and to guide the placement of groundwater monitoring wells. The fixed-base laboratory was used to confirm screening results and to provide data necessary to conduct the preliminary risk assessment (PRA).

Supplemental groundwater investigations conducted in October and November of 1997 included the installation and sampling of four additional monitoring wells to confirm that there were no significant impacts associated with potential contaminant releases from three source areas (i.e., the former fueling area, the former leaching well and the former motor pool fence line) identified by the Massachusetts Department of Environmental Protection (MADEP) as AOCs requiring further investigation. Supplemental soil investigations conducted in February of 1998 involved resampling previous RI surface and subsurface soil locations using MADEP's extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) methods.

Based on the findings and conclusions resulting from the 1993/1994 RI activities and the 1998 supplemental soil investigations, no further action is recommended for soils at AOC FS-17, since no significant risks were found. Although levels of arsenic and manganese found in site groundwater pose a slightly elevated human health risk under a future residential scenario, no further action is recommended for groundwater, since arsenic was found well below the maximum contaminant level (MCL) and the presence of manganese is not considered to be related to historic site activities or uses. The 1997 supplemental groundwater investigations also support no further action for site groundwater, since the results verify that no impacts have occurred associated with the AOCs identified by MADEP.

Currently a response to comments letter on the 1998 Supplemental Soil Investigation, no further action recommendation has been forwarded to the U.S. Environmental Protection Agency (USEPA) and MADEP with a request for approval by November 12, 1998.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Based on the findings and conclusions resulting from the 1993/1994 RI activities and the 1998 supplemental soil investigations, including the conclusions of the PRA, no further action is recommended for soils at FS-17 because no unacceptable risk to human health and the environment was found. In addition, although levels of arsenic and manganese found in site groundwater pose a slightly elevated human health risk under a future residential scenario, no further action is recommended for groundwater, because arsenic was found well below the MCL, and the presence of manganese is not considered to be related to historic site activities or uses. The 1997 supplemental groundwater investigations also support no further action for site groundwater, because the results verify that no significant impacts have occurred associated with the areas of concern identified by MADEP. Existing wells will be resampled in November 1998, prior to issuance of the draft record of decision (ROD) in February 1998.

Existing wells will be resampled in November 1998, prior to issuance of the draft ROD in February 1999 for regulatory review.



Statement of the Continued Protection of Human Health and the Environment

The results of the Massachusetts Contingency Plan Method 1 risk characterization conducted using the 1998 supplemental soil samples analyzed for VPH/EPH show a condition of "no significant risk of harm to health, public welfare or the environment" under current or future site uses, since all calculated exposure point concentrations (EPCs) are below MADEP's S-I/GW-1 standards.



APPENDIX D.2

Site Name: Fuel Spill-19 Former MOGAS Fuel Storage and Point

Site Description

AOC FS-19 was operated as a World War II vehicle fuel storage and distribution facility (Figure 4). In 1941, six 10,000-gallon USTs were installed at the FS-19 site; they were operated until 1958. Between 1958 and 1965, the six USTs were used for the storage of hazardous waste. The quantity of fuel and the type and quantity of waste that was stored and that may have leaked from, or been spilled during, the operational history of the USTs is unknown. In 1965, the six USTs were reportedly emptied and the fill pipes capped. In May 1985, however, it was determined that the USTs still contained approximately 7,000 gallons of a waste fuel/solvent mixture. In October 1989, the USTs were removed. In addition to the former fueling facility, AOC FS-19 is also the location of former Building 3493, which was located approximately 200 ft northeast of the former UST area. It has been reported by base personnel that hazardous wastes were once stored in Building 3493. As part of this investigation, the potential for this location to be a source area was also considered.

Environmental investigations have been conducted at this site since 1985. In September 1985, the U.S. Army Environmental Hygiene Agency (AEHA) installed water table monitoring well AEHA-9 to determine the effect of historic activities on site groundwater. Although sampling in April, May, and June 1986 did show the presence of volatile organic compounds (VOCs), levels were generally below federal and state MCLs. Between October 1989 and March 1990, ABB Environmental Services, Inc. (ABB-ES), conducted a two-phase SI. The SI activities included drilling three soil test borings and installing two monitoring wells. Although soil analyses did not show detectable levels of contaminants, groundwater analyses revealed low levels of chlorinated solvents and levels of dissolved sodium, vanadium, and zinc in excess of MMR background concentrations. Therefore, RI activities were recommended for AOC FS-19.

Discussion of Remedial Objectives

The remedial objectives for this site were to accurately define the presence or absence of hazardous materials at the site and make recommendations based on that information. The RI for AOC FS-19 was designed to further characterize potential soil and groundwater contamination in two suspected source areas, evaluate site hydrogeology, and determine potential risks to human health and the environment posed by contamination present at the site. The field exploration program for AOC FS-19 included soil sampling with Geoprobe equipment in 17 locations, surface soil sampling at three locations, drilling two soil test borings, installing two groundwater monitoring wells, and collecting groundwater samples. The hydrogeologic investigation included measuring depths to static groundwater and performing in situ hydraulic conductivity tests on all existing and newly installed wells.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Based on the findings and conclusions resulting from the 1993/1994 RI activities and the 1998



supplemental soil investigations, including the conclusions of the PRA, no further action is recommended for soils at FS-19 because no unacceptable risk to human health and the environment was found. In addition, although levels of arsenic and manganese found in site groundwater pose a slightly elevated human health risk under a future residential scenario, no further action is recommended for groundwater because arsenic was found well below the MCL and the presence of manganese is not considered to be related to historic site activities or uses. The 1997 supplemental groundwater investigations also support no further action for site groundwater because the results verify that no significant impacts have occurred associated with the AOCs identified by MADEP. Existing wells will be resampled in November 1998, prior to issuance of the draft ROD in February 1999 for regulatory review.

Comments on draft final remedial investigation were due November 11, 1998 from regulatory agencies.

Statement of the Continued Protection of Human Health and the Environment

The results of the Massachusetts Contingency Plan Method I risk characterization conducted using the 1998 supplemental soil samples analyzed for VPH/EPH show a condition of "no significant risk of harm to health, public welfare or the environment" under current or future site uses because all calculated EPCs are below MADEP's S-I/GW-1 standards.

Based on the findings and conclusions resulting from the 1993/1994 RI and the 1998 supplemental soil investigations, no further action is recommended for soils at AOC FS-19 because no significant risks were found. Although levels of arsenic and beryllium found in site groundwater pose a slightly elevated human health risk under a future residential scenario, no further action is recommended for groundwater at AOC FS-19 because these compounds were found at or near background.



APPENDIX E Sites in Progress Pending Records of Decision Requiring Remedial Action
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List of Sites

E.1	Ashumet Valley Groundwater Operable Unit	E-1
E.2	Chemical Spill-4 Groundwater Operable Unit	E-5
E.3	Chemical Spill-10 Groundwater Operable Unit	E-7
E.4	Eastern Briarwood (LTM only)	E-10
E.5	Fuel Spill-12 Groundwater Containment System	E-12
E.6	South West Operable Unit (SWOU)	E-15
E.7	*Fire Training Area-2/Landfill-2	E-20
E.8	Landfill-1 Groundwater Operable Unit	E-24
E.9	*Petroleum Fuel Storage Area/Fuel Spill-10/Fuel Spill-11	E-28
E.10	*Storm Drain-2/Fuel Spill-6/Fuel Spill-8	E-31
E.11	*Storm Drain-3/Fire Training Area-3/Coal Yard-4	E-33
E.12	*Storm Drain-4	E-35
E.13	*Storm Drain-5 Source/Fuel Spill-5	E-37
E.14	Storm Drain-5 Groundwater Containment System	E-39
E.15	Western Aquafarm (LTM only)	E-44

*These sites are included as part of the 6 AOC's. Appendix E-7 will serve as a reference for the 6 AOCs and the other sites will reference back to E.7 in an effort to reduce duplicate text



APPENDIX E.1

Site Name: Ashumet Valley Groundwater Operable Unit

Site Description

The Ashumet Valley plume originates at the former Firefighter Training Area 1 (FTA-1), with contribution from the decommissioned MMR sewage treatment plant (CS-16/CS-17) about 1,000 feet to the south (Figure 5).

Source

Treatment of contaminated soils at FTA-1 began in June 1995 and was completed in September 1997. A total of 46,172 tons of soil was treated using a thermal treatment process *MMR Draft Closure Report, FTA-1 Site, October 1997 (Jacobs)*. Soil cleanup objectives were met, the area was restored, and the source area no longer contributes to the Ashumet Valley groundwater plume. For the former sewage treatment plant, the remedial investigation, which defines the nature and extent of contamination, has been completed. A feasibility study that outlines options for addressing the contamination is being reviewed. A proposed plan that describes AFCEE's preferred alternative for addressing the former sewage treatment plant (CS-16/CS-17) was released for public comment in September 1998. Following public comment, a record of decision describing the final decision was released; in December 1998. Once the record of decision has been signed, design and construction of the selected remedy will begin.

The Ashumet Valley plume is roughly 10,000 feet long, a maximum of 4,500 feet wide, and averages 30 to 50 feet thick. In general, the plume is more than 60 feet below ground and 50 feet below the water table along most of its length.

The plume extends from the southern base boundary past Ashumet Pond and Carriage Shop Road in Falmouth, toward Route 28.

The primary contaminants of the Ashumet Valley plume are TCE, PCE, and 1,2-DCE. TCE has been found as high as approximately 50 ppb. The safe drinking water standards, or MCLs, for these contaminants are 5 ppb for each. PCE and TCE are common solvents associated with cleaners, solvents, paint thinners, and other wastes. Other inorganic contaminants associated primarily with the former sewage treatment plant, such as phosphorus and nitrates, also have been detected.

A pilot test of recirculating well technology began in the eastern lobe of the Ashumet Valley plume in March 1997. The purpose of the test was to determine whether recirculating well technology could effectively capture the plume and reduce contaminant concentrations in the groundwater. The test was completed in August 1997. The test results enabled AFCEE to determine that recirculating well technology could successfully capture groundwater contaminants.

The Ashumet Valley plume was one of four plumes to undergo the "decision criteria" process in 1997, a public process that enabled the remedial project managers and the public to compare and evaluate cleanup alternatives.



In September 1997, after careful consideration of the advantages and disadvantages of each plume response alternative and comments received during the public comment period, the remedial project managers from AFCEE, EPA, and MADEP decided on an alternative to treat the Ashumet Valley plume.

The selected alternative uses ETR technology to achieve a significant degree of plume capture. To help restore the Falmouth well field within a reasonable time, an axial fence will be placed within the plume, in the vicinity of the Crane Wildlife Area, to capture and treat VOCs to background levels. To help protect Ashumet Pond, an ETR fence to capture phosphorus and VOCs will be located along the northwest shore of the pond.

The decision also features provisions to relieve nitrate loading in surface waters south of the plume, to investigate the southeast part of the plume, to minimize the effects of construction in neighborhoods, and to reduce adverse effects on natural resources.

Discussion of Remedial Objectives

The decision criteria process used for selecting the cleanup alternative was developed cooperatively by AFCEE, EPA, and MADEP. It includes requirements of federal and state environmental regulations but was tailored to meet the specific needs and interests of the projects and concerns of the community surrounding MMR.

The DCM is a tool presenting criteria against which plume response alternatives are measured, compared, and evaluated. Basically, the criteria answer the following questions about each alternative:

- Does it meet basic requirements? (called “threshold” criteria)
- How well will it work? (called “primary balancing” criteria)
- Is it acceptable to stakeholders? (called “acceptance” criteria)

In cooperation with hydrological, ecological, human health, and other technical specialists, the RPMs have evaluated how well each plume response alternative meets each of the threshold and primary balancing criteria and have used *Consumer Reports*-type symbols to fill in the matrix. Their analysis is contained in the document entitled *Plume Response Decision Document*.

Threshold criteria apply to two basic requirements that an alternative must meet in order to be considered further: (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements (ARARs), which are the federal and state requirements that apply to MMR.

The primary balancing criteria are used to evaluate alternatives using both qualitative and quantitative information. The primary balancing criteria present the strengths and weaknesses of each alternative for comparison among alternatives.

Areas of Noncompliance

There are no areas of noncompliance.



Recommendations

After careful consideration of the advantages and disadvantages of each plume response alternative and comments received during the public comment period, the RPMs from AFCEE, EPA, and MADEP reached consensus that Alternative I with modifications best balances the decision criteria.

Alternative I with modifications best balances the objectives to restore the aquifer for use as a public water supply within a reasonable time frame, to provide significant mass capture, and to reduce human and ecological risks. This alternative also minimizes overall pumping rates on the aquifer and construction and operation impacts on neighborhoods.

The selected alternative uses ETR technology to achieve a significant degree of plume capture. To help restore the Falmouth well field within a reasonable time frame, an axial fence will be placed within the body of the plume to capture and treat VOCs to background levels. The fence will extend from the golf course north of Route 151 south through the Crane Wildlife Management Area to Hayway Road. To help protect Ashumet Pond, an ETR fence to capture phosphorus and VOCs will be located along the northwest shore of the pond.

The modifications to the selected alternative feature provisions to relieve nitrate loading in surface waters south of the plume, to investigate the southeast portion of the plume, to minimize neighborhood construction impacts, and to reduce impacts to natural resources.

In addition, remediation of the source area will continue as an important part of the overall cleanup of the plume. The sewage treatment beds ceased operations in December 1995 and the soil cleanup at FTA-1 was completed in September 1997. Studies will continue to examine and evaluate phosphorus and other pond nutrients as well as the overall continued health of the pond.

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The selected alternative improves on the threshold criteria in the matrix by minimizing the hydraulic impacts on the aquifer. The total pumping rate for the selected alternative is 300,000 to over one million gallons per day less than the other alternatives.

The central axial extraction fence and reinjection system reduces the contaminant mass in the plume and restores the aquifer for drinking water use within a reasonable time frame. The fence also hydraulically controls the deeper portion of the plume and keeps a majority of the plume within its current footprint. This axial fence also prevents a portion of the plume from migrating into low-hydraulic-conductivity silts.

Installation of the ETR system will require close coordination with the golf course north of Route 151 and the Crane Wildlife Management Area between Route 151 and Hayway Road to ensure construction and operation impacts are minimized and site restoration is appropriate for the affected land uses.

Pumping and treating in the northern portion of the plume may cause adverse reactions in the production of nitrates. This concern will be considered in the design of the axial fence.



This extraction fence will capture and treat phosphorus in the northeast portion of the plume upgradient of Ashumet Pond and prevent it from discharging into the pond. An ETR system was chosen because of its demonstrated reliability in similar hydrological conditions. The design will seek to minimize impacts on the pond and the U.S. Geological Survey (USGS) test well site.

The Air Force will fund \$8.5 million of activities over the next three to five years to improve ground and surface waters. The provision for nitrate offsets allows the Air Force, in close consultation with the Town of Falmouth, to take actions to improve water quality of surface waters south of the Ashumet Valley plume. These water bodies include, but are not limited to, Green Pond, Mill Pond, Bourne Pond and Great Pond. The improvements may include septic system upgrades, public sewer hookups, surface water treatment, constructed wetlands, or other appropriate activities.

This direct approach was considered to have a more immediate impact on the ecological health of the surface waters than treating low levels of nitrates in the body of the plume.

The process of MNA will reduce the mass of the plume through biodegradation, dispersion, and dilution from recharge. AFCEE and EPA protocol for natural attenuation require characterization of contaminant trends, determination of physical and geochemical conditions, and determination of degradation products in the plume. Modeling, as well as long-term monitoring (LTM), is required to predict and confirm the process of natural attenuation.

In addition, all residents who are within or near the current footprint of the plume will be supplied with town water, keeping the site protective of human health and the environment.



APPENDIX E.2

Site Name: Chemical Spill-4 Groundwater Operable Unit**Site Description**

Study Area CS-4 is located 1.1 miles from the southern MMR boundary on the southwestern side of West Truck Road (Figure 5). Study Area CS-4 was operated for maintenance of military vehicles by the U.S. Army from 1940 to 1946, and by the USAF from 1955 to 1973. Wastes generated and potentially spilled or dumped during this period included oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels.

In addition to motor pool activities, the base DPDO maintained a storage yard in the northern portion of Study Area CS-4 between 1965 and 1983. Wastes were transported to the DPDO from shops and laboratories operating at MMR. Wastes and equipment handled at Study Area CS-4 included transformers, electrical equipment, waste oils, solvents, and waste fuels. Liquid wastes were stored in containers or tanks in an unbermed area, or deposited in six 5,000-gallon USTs installed to store motor gasoline when the motor pools were operational. These USTs were used until January 1984; in September 1984, the last USTs used for waste storage were emptied and removed. The area has been inactive since 1986.

The source of the CS-4 groundwater plume is a former motor pool used from 1941 to 1973 and a Defense Reutilization and Marketing Office that operated from 1956 to 1983. Spills, leaks, and disposal at the area have resulted in a groundwater plume.

The four primary contaminants of the CS-4 plume are PCE, TCE, 1,1,2,2-tetrachloroethane (1,1,2,2-TCA), and 1,2-DCE, at levels historically below 100 ppb. The safe drinking water standard, or MCL, for each is 5 ppb.

The CS-4 plume extends from south of the Otis Golf Course, underneath the Crane Wildlife Management Area and terminates just North of 151. It is about 11,250 feet long, 120 feet below ground surface, 550 feet wide, and 40–50 feet thick.

A plume containment system consisting of 13 groundwater extraction wells, a carbon treatment facility, and an infiltration gallery began operation in November 1993. Evaluations of the system completed in 1997 raised questions as to whether the system is effectively capturing the western part of the plume or whether the plume is moving downward just before the containment fence.

Discussion of Remedial Objectives

As stated in the Interim Record of Decision for CS-4 Groundwater Operable Unit, response objectives for the Study Area CS-4 Groundwater Operable Unit FFS are as follows:

- Protect uncontaminated groundwater and surface water for future use by minimizing the migration of contaminants.
- Restore contaminated groundwater for future use by reducing contaminant concentrations within the plume to safe drinking levels.



Southwest Operable Unit remedial investigation and feasibility study indicates CS-4 contamination groundwater plume. Revised remedial action objectives have been proposed and a remedy for CS-4 groundwater plume will be selected in the SWOU Record of Decision.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Since clean up for the CS-4 plume have not been met another five year review is recommended.

Statement of the Continued Protection of Human Health and the Environment

The installed treatment system is expected to be effective in extracting the CS-4 Groundwater Operable Unit from the aquifer. A final remedy for the CS-4 groundwater plume will be selected within the SWOU ROD. The five-year system significantly reduces the period that upgradient water remains a potential hazard. However, future upgradient water users are unlikely because the plume underlies the Crane Wildlife Management Area, where no development is allowed, and MMR, where water development can be controlled.



APPENDIX E.3

Site Name: Chemical Spill-10 Groundwater Operable Unit

Site Description

The primary contaminants of the CS-10 plume are TCE, PCE, and 1,2-DCE). TCE has been detected in the western portion of the plume as high as 400 ppb and in the southeastern portion of the plume as high as 2,800 ppb, although there have been isolated detections of higher concentrations. EDB has been detected sporadically at low levels. The safe drinking water standard, or MCL, is 5 ppb for TCE, PCE, and 1,2-DCE. PCE and TCE are common solvents used for equipment maintenance and degreasing. EDB was added to leaded gasoline, including AVGAS, to inhibit the buildup of lead in engines.

Most of the CS-10 plume affects the south-central area of the base. The plume is about 17,000 feet long, a maximum of 4,000 feet wide, and up to 140 feet thick. In general, the plume is more than 120 feet below ground and 60 feet below the water table along most of its length (Figure 5).

The eastern lobe of the plume has migrated off base in the groundwater near the Falmouth Gate. It has been tracked to the edge of Ashumet Pond. Additional drilling and sampling began in October 1998 to determine whether the plume is flowing deep under Ashumet Pond. None of the primary contaminants in the plume have been detected in the surface water of Ashumet Pond.

The primary sources of the CS-10 groundwater plume are the 38-acre area of the former Boeing Michigan Aeronautical Research Center (BOMARC) Missile Site and Unit Training Equipment Site (UTES) located near the eastern boundary of MMR. The BOMARC Missile Site was operated between 1962 and 1973, and UTES has operated since 1978 to maintain and store armored and other wheeled vehicles. Spills and releases of chemicals occurred in these areas in the past. A preliminary pollution prevention program has been in place at UTES since December 1995 to ensure that petroleum use and disposal do not affect the groundwater (Figure 5).

Two pilot tests of recirculating wells began in the eastern lobe of the CS-10 plume near the boundary of the base in December 1996 and are scheduled to run until 1999.

The CS-10 plume was one of four plumes to go through the "decision criteria" process in 1997, a public process that enabled the remedial project managers and the public to compare and evaluate cleanup alternatives.

In August 1997, after careful consideration of the advantages and disadvantages of each plume response alternative and comments received during the public comment period, the RPMs from AFCEE, EPA, and MADEP decided on an alternative to treat the CS-10 plume. The selected alternative uses ETR technology. An extraction fence will be constructed along Sandwich Road; it is expected to be activated in May 1999, at which time the recirculation well pilot systems will be shut off. A CS-10 in plume remedy has been designed and is expected to begin operations by June 28, 1999. Southwest and southern fence remedies will be selected and are expected to begin operations by April 2000.



Discussion of Remedial Objectives

The decision criteria process used for selecting the cleanup alternative was developed cooperatively by AFCEE, EPA, and MADEP. It includes requirements of federal and state environmental regulations but was tailored to meet the specific needs and interests of the projects and concerns of the community surrounding the MMR.

The DCM is a tool presenting criteria against which plume response alternatives are measured, compared, and evaluated. Basically, the criteria answer the following questions about each alternative:

- Does it meet basic requirements? (called “threshold” criteria)
- How well will it work? (called “primary balancing” criteria)
- Is it acceptable to stakeholders? (called “acceptance” criteria)

In cooperation with hydrological, ecological, human health, and other technical specialists, the RPMs have evaluated how well each CS-10 plume response alternative meets each of the threshold and primary balancing criteria and have used *Consumer Reports*-type symbols to fill in the matrix. Their analysis is contained in the document entitled *CS-10 Plume Response Decision Document*.

Threshold criteria apply to two basic requirements that an alternative must meet to be considered further: (1) overall protection of human health and the environment and (2) compliance with ARARs, which are the federal and state requirements that apply to MMR.

The primary balancing criteria are used to evaluate alternatives using both qualitative and quantitative information. The primary balancing criteria present the strengths and weaknesses of each alternative for comparison among alternatives.

The acceptance criteria portion of the draft matrix has been purposely left blank. Acceptance criteria will be evaluated by acceptance groups, which include the public at large, affected neighborhoods, citizen teams, Senior Management Board selectmen, the Massachusetts Department of Public Health, the U.S. Agency for Toxic Substances and Disease Registry, Natural Resource Trustees, EPA, MADEP, and Department of Defense.

In addition, the recirculating wells in the area of higher contaminant concentration north of Sandwich Road will continue to operate and provide ongoing reduction of contaminant mass during design and construction of the Sandwich Road well fence. The Air Force will continue to monitor the progress and operation of the recirculating wells.

The decision process was completed in August 1997, and a project execution plan was written and approved in September 1997. A sampling and analysis plan has been implemented, and monitoring wells were installed through spring 1998. On-going ecological sampling is being conducted. Thirty-four wells were sampled for data-gap analysis to prepare the treatment system design. Final engineering design work will continue throughout 1998 to complete construction to meet a treatment system startup date for the Sandwich Road well fence and in-plume treatment



system of June 28, 1999. EPA granted an extension for the treatment system associated with the South/Southwest well fence to reevaluate it as part of the SWOU. It is now scheduled for completion in April 2000.

Components of the selected alternative include the Sandwich Road ETR fence, the Southern ETR fence, the Southwest ETR fence, and the additional refinement of in-plume action. The Sandwich Road ETR fence will capture the mass of contaminants at and just north of Sandwich Road. The Southern ETR fence will protect existing and future water supplies south of a portion of the CS-10 plume. The Southwest ETR fence will protect an uncontaminated portion of the aquifer southwest of the plume. In-plume action will seek to reduce the mass of contaminants entering the silts, reduce higher concentrations of contaminants before they reach the ETR well fences, minimize hydrological impacts, and improve the performance of the system. The South/Southwest ETR fences are currently being reevaluated as part of the SWOU investigation.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

- Currently there is an IROD from September 1995 addressing groundwater cleanup. Now that the groundwater remedy is being implemented a final ROD documenting the remedy needs to be prepared. It is scheduled for late fiscal year 1999, or early fiscal year 2000. Since clean up levels for groundwater contaminants are unlikely to be met within five years, it is recommended that a five year review after implementation of components of the CS-10 ETR systems be conducted.

Statement of the Continued Protection of Human Health and the Environment

Currently, groundwater within the footprint of the CS-10 is not being used for drinking water supplies, therefore there are no human health risks. The uncaptured portion of the CS-10 plume downgradient of the Sandwich Road extraction fence does not pose a risk to receptors at Ashumet Pond. The CS-10 extraction system has been designed to have the fewest impacts on ecosystems.



APPENDIX E.4

Site Name: Eastern Briarwood (LTM only)

Site Description

The Eastern Briarwood groundwater plume extends from the southeast base boundary underneath the Eastern Briarwood property development between Johns Pond and Moody Pond. The plume is 3,000 feet long, 300 feet wide, and 20–30 feet thick. The top of the plume is 0–20 feet below the water table (Figure 5).

The Eastern Briarwood plume was originally scheduled for remediation. However, because the plume is very small, no one is using the groundwater for drinking water, and exceedences of drinking water standards were intermittent, remedial action was put on hold, and LTM was implemented.

A specific source area for the Eastern Briarwood groundwater plume was not defined during investigations conducted thus far. Groundwater contamination is believed to emanate from several locations such as the former heat plant and various maintenance shops and hangars.

The primary contaminants are TCE and PCE. Historically, the highest levels detected have been 19 ppb of TCE and 8 ppb of PCE. The safe drinking water standard, or MCL, for both compounds is 5 ppb.

Discussion of Remedial Objectives

A technical memorandum presented information supporting the position of excluding the Eastern Briarwood groundwater plume from the set of seven groundwater plumes selected for groundwater containment as the interim remedial action at MMR. Through review of the nature and distribution of contaminants and the associated human health risks, it is recommended that the final objective of remediation of the Eastern Briarwood plume will not be advanced under the current containment strategy of groundwater extraction and treatment (pump and treat). The following reasons are given:

- The Eastern Briarwood plume has reached steady state and does not extend beyond the base boundary, where the proposed groundwater extraction system would be located.
- Current analytical data indicates that groundwater quality is not deteriorating in the Eastern Briarwood plume and already meets cleanup criteria for almost all compounds throughout the extent of the plume.
- The human health risks are mitigated because there are no groundwater receptors, and therefore no completed exposure pathway, within the extent of contamination.
- The primary source of contamination has been removed.

Areas of Noncompliance

There are no areas of noncompliance.



Recommendations

There is no conclusive analytical data that indicates groundwater contamination from the Eastern Briarwood plume is migrating past the MMR base boundary. In addition, biological degradation is effectively containing the distribution of primary contaminants (fuel-related VOCs) to the same extent proposed by the extraction-and-treatment system. Therefore, it is not practical to use pump-and-treat technology to remediate groundwater, which already meets cleanup criteria for most compounds. The secondary contaminants (dissolved inorganic compounds) will naturally precipitate as dissolved oxygen (DO) levels rise to background concentrations.

After consideration of all data and analysis, an agreement was reached in 1996 between AFCEE and EPA and DEP that long-term monitoring was the best approach for the Eastern Briarwood groundwater plume. The reasons for the decision include the fact that 1) there are very low concentrations of contaminants; 2) currently, no one is using the groundwater for drinking water purposes; and 3) the vertical and lateral extent of the plume is relatively small. The results showed that there has been little change in the Eastern Briarwood area over the past two years. However, recently obtained information has shown several detections of EDB at much deeper levels than the shallow TCE plume associated with Eastern Briarwood. AFCEE will continue to further investigate the area based on these new findings. The extended outlook for this plume is continued long-term monitoring.

Statement of the Continued Protection of Human Health and the Environment

It is important to note that there are no private drinking water wells within the Eastern Briarwood area. In addition, EDB was not been detected in the Quashnet River at the surface water station located downgradient of 00MW0573 during the three quarterly sampling events conducted between April and July 1998.

Long term monitoring will continue to ensure that the site remains protective of human health and the environment.



APPENDIX E.5

Site Name: Fuel Spill-12 Groundwater Containment System**Site Description**

The source of the Fuel Spill 12 (FS-12) groundwater plume is a confirmed leak during the early 1970s in a now-abandoned fuel pipeline along Greenway Road at MMR. MADEP is overseeing a project that is testing and evaluating the pipeline for any other leaks.

As a result of the FS-12 pipeline leak, nearly 70,000 gallons of aviation fuel entered the soil. The fuel was located near the top of the groundwater in the aquifer. Since October 1995, AFCEE has removed over 44,580 pounds of contaminants using a process called vapor extraction and air sparging. Contaminant removal has been completed; confirmation testing continues to ensure that the FS-12 source area has been cleaned up.

The primary contaminants of FS-12 are benzene and EDB, which are probable carcinogens. EDB was added to leaded gasoline, including AVGAS, to inhibit the buildup of lead in engines. The maximum levels detected are about 600 ppb for EDB and 1,600 ppb for benzene. The safe drinking water standards, or MCLs, are 0.02 ppb for EDB and 5 ppb for benzene.

The FS-12 pipeline leak created a groundwater plume about 4,800 feet long, a maximum 2,000 feet wide, 60–130 feet thick, and more than 90 feet below ground. It affects an area just south of the base near Snake Pond in Sandwich (Figure 5).

In 1997, AFCEE constructed an ETR system to contain and clean up the FS-12 groundwater plume. The system consists of 25 extraction wells to remove contaminated groundwater, a treatment plant, and 23 reinjection wells to return clean water to the aquifer. The treatment plant uses two systems to remove fuel compounds from the groundwater. The first, called “ultraviolet oxidation,” (UV/OX) uses ultraviolet light to degrade and remove most of the fuel compounds. The system typically is used only when contaminant concentrations exceed 500 ppb. This process is followed by activated carbon filters to remove residual fuel compounds. The fuel compounds adsorb to the activated carbon granules as they pass through the filter, and clean water is returned to the aquifer. The activated carbon filters are recycled off site at a licensed recycling facility.

Construction of the ETR remedial system began in November 1996, and system startup began on September 18, 1997, 6 days ahead of the EPA’s milestone. The system pumps about 1.1 million gallons per day. The water is sampled weekly to ensure that the system continues to perform properly. As of April, 1998, 293 million gallons of groundwater has been treated, and 71.1 pounds of benzene and 68.7 pounds of EDB have been removed.

All off-base construction and site restoration activities were completed by June 23, 1997 so that the property, a youth summer camp, was available for seasonal use. Site restoration included road and road shoulder repair (i.e., paving, grass seeding, shrub and tree planting), pond shoreline repair, and restoration of the camp athletic field (which was used to store equipment and materials during construction).



AFCEE performed an evaluation of the groundwater conditions downgradient of the Phase I extraction system. AFCEE then presented a case to EPA that only further monitoring was required. EPA concurred with this recommendation.

Discussion of Remedial Objectives

The actions proposed by the Air Force in response to the TRET recommendations consist of the installation of a groundwater remediation system to capture as near 100% of the plume as possible while minimizing ecological impacts to the Snake Pond area.

Objectives:

- Design, construct, operate, and monitor an ETR remedial system for the FS-12 plume.
- Contain, capture, and remediate the FS-12 plume.
- Minimize remedial system-induced adverse impacts to Snake Pond.
- Monitor treatment system performance.
- Avoid remedial system-induced adverse impacts to the J. Braden Thompson plume.
- Minimize disturbance to private property.
- Monitor groundwater quality to assess performance and improve design and operations at other sites.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

On November 12, 1998, with concurrence from EPA and MADEP, AFCEE announced that additional extraction wells will not be necessary for the cleanup of the FS-12 groundwater plume.

The FS-12 groundwater treatment system has been in operation since September 1997. As part of the groundwater cleanup plan monitoring wells were installed downgradient of the extraction well fence. The data collected since the well fence was installed verifies the system is working as designed and no further modifications are now needed.

AFCEE has implemented a monitoring program that evaluates treatment system performance and will continue to evaluate the data from that program with EPA and MADEP.

The FS-12 treatment system pumps approximately 800 gpm, or over 1 million gallons a day. As of September 1998, 400 million gallons of groundwater had been treated, and 72 pounds of benzene and 80 pounds of EDB had been removed.

The ETR system is operating as designed and is containing the FS-12 plume. No changes are required at this time, but some modifications to the extraction and reinjection flow rates would improve system performance slightly.

It is also recommended that Performance Monitoring Evaluations continue as scheduled.



Continue monitoring using the Phase II Project 2 monitoring wells and, once Phase II monitoring is complete (December 1999), add some of these Phase II wells to the PME monitoring well network.

Continue to monitor performance of the ETR system using the PME monitoring well network.

Continue to monitor groundwater downgradient of the FS-12 plume to evaluate system performance.

Monitor contaminant movement to confirm or revise the focused risk evaluation results as residuals of the contaminants isolated south of the ETR system disperse downgradient.

Statement of the Continued Protection of Human Health and the Environment

Based on the analysis completed in *MMR Plume Response Program, Draft FS-12 Phase II Technical Memorandum, October 1998*, the FS-12 EDB plume front residuals present no unacceptable risk to human health. The following conclusions may be drawn from the focused risk evaluation:

- Analysis of the data available on surface water levels, temperature, DO, and pH at this time supports the conclusion that there are no impacts that exceed ecological thresholds on study ecosystems due to the operation of the FS-12 ETR system.
- The uncaptured plume segment appears to have passed the initial monitoring well groups sampled during the September 1997–June 1998 time frame.

Assuming that an EDB-contaminated groundwater pulse does not disperse as it moves downgradient from the initial monitoring well groups and that residents draw groundwater from wells downgradient from the monitoring wells for domestic purposes, the most likely EDB ILCR would not exceed an estimated 3.1×10^{-6} for RME conditions or 6.7×10^{-7} for CT exposures. These ILCR are below the performance standard of 1×10^{-5} agreed upon by the RPMs for MMR site. Therefore, the FS-12 EDB plume front residuals present no unacceptable risk to human health.



APPENDIX E.6

Site Name: South West Operable Unit (SWOU)**Site Description**

Based on the findings of the SWOU Remedial Investigation Report, there are six contaminated Groundwater plumes within the SWOU, which is the area between Landfill No. 1 (LF- 1) and Chemical Spill No. 10 (CS-10) plumes. In addition to the known plumes, CS-4, FS-13 and FS-28, three plumes were identified. They are: CS-20, CS-21, and FS-29.

The MMR Plume Response Program Draft SWOU RI (October 1998) consisted primarily sampling groundwater, surface water, and sediment; characterizing the physical site setting; and performing human health and ecological baseline risk assessments. Groundwater within the SWOU is contaminated primarily by organic constituents, most significantly EDB, TCE, PCE, and CCl₄, which are present above drinking water standards. Other VOCs present at relatively low concentrations include chlorinated solvents and their associated breakdown products and a few fuel-related constituents. Lead and thallium are also present at concentrations greater than drinking water standards; aluminum, iron, and manganese were detected at concentrations exceeding secondary drinking water standards. The elevated levels of metals may be related to geochemical conditions produced as a result of biological degradation of fuels in groundwater, or they may be characteristic of regional groundwater chemistry.

All of the principal SWOU plumes are detached and relatively mobile, with the exception of the FS-13 plume, which is small and locally confined to the shallow groundwater at its source area. The transport of the organic contaminants is controlled primarily by advection, with average linear velocities ranging from 0.003 feet/day to 3 feet/day. Sorption to organic matter on the aquifer matrix has a relatively minor affect on the plume constituents. The fuel-related contaminants (with the exception of EDB), while not very prevalent within SWOU groundwater, are subject to biodegradation and sorption, which have historically and are currently reducing their concentrations and limiting their mobility. Inorganic constituents, while prevalent within the SWOU, are not very mobile and will remain sorbed to the aquifer matrix.

The magnitude of contribution of contamination to the groundwater in the SWOU was assessed for each potential source area. The investigation looked specifically at: the site-specific historical use of diesel, MOGAS, AVGAS, and chlorinated solvents, including the frequency of documented leaks of these contaminants into the underlying soil and groundwater; and the use of herbicides, pesticides and fumigants. The use of CCl₄ and EDB as fumigants on MMR was also investigated. The U.S. Department of Agriculture stated that to their knowledge, CCl₄ and EDB were never used as a fumigant on MMR. However, no documentation was available to confirm this.

Many source areas could be regarded as contributors to the SWOU. Several areas may have released or received varying amounts of fuels and/or solvents at various times. The following sites were included in the review, but all were eliminated as potential sources to the groundwater contamination in the SWOU: FTA-1, CS-1, CS-5, CS-11, FS-27, CS-3/FS-23, USCG/CS-6, USCG/FS-26, CY-1, CY-2, CY-3, USCG/LF-2, Osborn Pond, Campbell School grounds, Otis



Golf Course, Cape Cod Country Club, the dry-cleaning facility on base, and the former Coonamessett Airfield. The contribution of contamination into the groundwater of the SWOU from the Former Munitions Storage/Former Base Housing study area and the railroad maintenance pit cannot be determined due to a lack of historical and analytical information. The LF-1 source area was not included in the review of potential source areas because although the LF-1 plume extends into the SWOU study area, this source area and its associated plume are not included as part of the SWOU RI.

The remaining sites were classified into three groups: minimal contributors to SWOU groundwater contamination, contributors to SWOU groundwater contamination, and significant contributors to SWOU groundwater contamination. The potential contribution to groundwater contamination was determined from documented use of contaminants of potential concern (i.e., fuels, chlorinated solvents, herbicides, pesticides and fungicides), aquifer characteristics (lithology, hydraulic conductivity and groundwater flow direction), and geomorphology.

The study area of U.S. Coast Guard (USCG) FS-2 was the only area identified as a minimal contributor to the groundwater contamination in the SWOU. Dissolved, weathered, fuel-related compounds are found downgradient of USCG/FS-2, and the groundwater flow is to the southwest, in alignment with the groundwater flow in the SWOU. However, it is undetermined whether the contaminants originated from USCG/FS-2 or from other sites upgradient of the study area.

Study areas CS-4 SSI, USCG/CS-3, CS-9, FS-2, FS-7, FS-9, FS-13, FS-18, and FS-19 were identified as possible contributors to groundwater contamination in the SWOU. These sites have a history of fuel and/or solvent releases coupled with a southwesterly groundwater flow that would cause contaminants to migrate into the SWOU.

CS-10 and CS-4 were identified as significant contributors to the groundwater contamination in the SWOU. Concentrations greater than drinking water standards of EDB and chlorinated solvents such as TCE, PCE and DCE were detected in groundwater in the eastern and western lobes of the CS-10 plume, which originates, in part, from the UTES, BOMARC, and FS-24 source areas. The CS-4 study area displayed exceedences of MCLs for both chlorinated solvents and fuel-related compounds in groundwater with a southwesterly flow, which is in alignment with the groundwater flow of the SWOU. The CS-4 plume is being treated separately, see appendix F.2.

The potential source areas reviewed as part of this investigation were in various stages of the investigation and remediation process in October 1998. The SWOU study represents the groundwater conditions in the area in a snapshot in time. Going forward, the FS-28 EDB plume, as defined and revised in the SWOU, will be referenced.

Since October 1997, when the treatment system became operational, most of the FS-28 plume in this location has been captured by the extraction well, treated, and discharged to the Coonamessett River in the area of greatest groundwater discharge. The thickest portion of the plume (approximately 220 feet) occurs downgradient of the extraction well, where the discharge to the surface water occurs. Because the extraction well has been operating for a relatively short



time, there is still a portion of the plume that has not been captured by the extraction well and continues to discharge into the Coonamessett River and associated cranberry bogs.

A Time-Critical Removal Action was undertaken by the Air Force Center for Environmental Excellence (AFCEE) in July 1997 for the leading edge of the 1,2ethylen dibromide (EDB) plume associated with Fuel Spill-28 (FS-28). The plume was found to have migrated south of the Massachusetts Military Reservation (MMR), in Barnstable, Massachusetts. The removal action was implemented to prevent long-term human exposure to EDB found upwelling into the surface waters of the Coonamessett River. This action included installing a deep extraction well (69EW0001) and an aboveground granular-activated carbon (GAC) treatment system that discharges treated water back to the river system. The well was installed in April 1997 and the treatment system went into continuous operation on October 14, 1997.

Discussion of Remedial Objectives

Remedial action objectives (RAOs) for each plume were proposed in the Feasibility Study and will be documented in the Record of Decision for the SWOU. For the plumes in the SWOU, the two general RAOs are: reduce potential human health risks from exposure to contaminated groundwater, and return groundwater to beneficial uses within a reasonable timeframe. Since the FS-28 plume discharges to surface water of the Coonamessett River, an additional RAO for this plume is reduce potential human health risks from exposure to contaminated surface water.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the SWOU be reevaluated in the next five-year review. By this time, implementation of SWOU remedies to be selected in the ROD will likely be completed.

Statement of the Continued Protection of Human Health and the Environment

Although remedies are not in place for all the plumes in the SWOU, a number of actions have been taken to protect human health and the environment.

The following is a summary of actions that have been conducted for the CS-4 and FS-28 groundwater plumes.

- operation of an ETR fence for the toe of the CS-4 plume to begin restoration of the aquifer
- as part of the time-critical removal action for FS-28. protection of human health was addressed by the following actions:
 - provision of bottled water and information about the EDB contamination to 35 residents prior to installing connections to the public water supply
 - 128 public water supply residential connections
 - wellhead treatment at the Coonamessett Water Supply Well
 - monthly collection and analysis of surface water samples along the Coonamessett River
 - collected air samples in the area around the confluence of the Broad and Coonamessett Rivers to evaluate and inhalation risks to residents, recreational users, and workers.
 - installation of an extraction (EW-1), treatment, and discharge system to extract the hot-spot of EDB in the FS-28 plume before it discharges to the surface water



- replacement of irrigation wells along the Coonamessett River that may be extract contaminated Groundwater
- as part of the non-time critical removal action for FS-28, protection of human health was addressed by the following actions:
 - continued operation of ETD system
 - additional extraction of contaminated groundwater by shallow well points
 - alternate water supply for flooding of boas by installation of piping from existing treatment plant to bogs
- investigations in the SWOU as presented in the RI Report reached the following conclusions:
 - no ecological risk to warrant remedial action; however. continued protection of the environment from impacts of the FS-28 ETD system will be continually evaluated in the ecological sampling program
- no current human health risks are present from portions of the plumes either on the base or in the Crane Wildlife Management Refuge, however the risk assessment concluded that there are risks from use of Groundwater in these areas in a residential scenario there are no current or future risks associated with swimming in either Deep or Coonamessett Ponds since no contaminants were detected
- additional 37 residential connections on Cloverfield Way and portions of Boxberry Hill Road
- continued residential sampling program in areas of Falmouth potentially impacted by MMR plumes

Section 121 of CERCLA mandates that a remedial action must protect human health and the environment, therefore SWOU ROD will ensure the overall protection of human health and environment by the selected remedies for the SWOU plumes.

The human health risk assessment performed in the MMR Plume Response Program, Draft SWOU Investigation (October 1998) conservatively quantified cancer and noncancer risk from current and future exposure. An unacceptable cancer risk could exist for future exposure to groundwater throughout this site, but presently there is no human exposure to groundwater contaminated at concentrations above drinking water standards. When mean groundwater concentrations are considered, the future cancer risks are within EPA risk management criteria but exceed MADEP criteria.

The cancer risks based on maximum exposure to maximum concentrations of river contaminants for a cranberry worker are below the MADEP risk criteria. However, the maximum risks for a river fisher are higher than the MADEP risk criteria. When mean surface water and sediment concentrations of river contaminants are considered, river cancer risk is below regulatory limits. Unacceptable noncancer hazards could also exist for future exposure to SWOU groundwater but not for current or future exposure to surface water.

The ecological risk assessment for SWOU surface water and sediment found that several metals may have an ecologically significant impact on populations or individuals of protected species.



EDB-contaminated groundwater is known to emerge into the Coonamessett River, but with the possible exception of lead, there is no indication that the same relationship exists for metals, which are not considered MMR-related contaminants. Therefore, since MMR-related organic contaminants are not driving the ecological risk and the risk is primarily attributable to background levels of metals (with the possible exception of lead) in emerging groundwater, surface water, and sediment, future remedial action should be driven by human health risk.



APPENDIX E.7

Site Name: Fire Training Area-2/Landfill-2**Site Description**

Prior to landfilling, the topography of the area of concern (AOC) consisted of a prominent north-south swale connected to the current Study Area SD-1 drainage ditch on the southern side of South Outer Road (Figure 5). As a result of landfilling, the AOC no longer has a surface drainage channel and the ground surface is level to gently sloping; incident precipitation largely infiltrates and recharges groundwater. The ground surface is vegetated with grass and scattered trees. Two 72-inch-diameter pipes, installed in the landfill at AOC FTA-2/LF-2 in approximately 1962, carry runoff south from AOC SD-5/FS-5 through AOC FTA-2/LF-2 and discharge the runoff to Study Area SD-1. AOC FTA-2/LF-2 is located within the flightline security area. Access to areas within the flightline area is controlled with fences and guard posts, and activities not related to aircraft operations are limited and strictly controlled. Fences around the flightline areas are inspected daily by base security. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal (Figure 5).

Investigations at AOC FTA-2/LF-2 detected fuel- and nonfuel-related semivolatile organic compounds (SVOCs) and inorganics in surface and subsurface soils. Fuel-related volatile organic compounds (VOCs) and pesticides were also identified in subsurface soils. Section 5.0 of the remedial investigation (RI) report discusses AOC FTA-2/LF-2 soil contamination in detail (ABB-ES, 1996a).

The Task 2-3B site investigation (SI) soil gas survey detected trace concentrations of chlorinated solvents including trichloroethylene (TCE), tetrachloroethylene (PCE), and/or trichloroethane in seven samples. Dichloroethylene (DCE) was also detected in the suspected vicinity of FTA-2.

In summary, available data indicate that the primary soil contaminants at AOC FTA-2/LF-2 are fuel-related VOCs and fuel- and nonfuel-related SVOCs. Inorganics are secondary contaminants at the site. The highest concentrations of VOCs and SVOCs were observed at the FTA-2 burn pit, which is interpreted to be the primary AOC-related source.

Results of the AOC FTA-2/LF-2 investigations identified three potential sources of VOC and SVOC contamination in groundwater at the AOC: FTA-2, LF-2, and the upgradient Western Aquafarm at AOC SD-5/FS-5 (see Subsection 7.6 of this Record of Decision). Of these, AOC SD-5/FS-5 is considered the most significant source of currently observed contamination. Groundwater sampling from the Task 2-3B SI and the Tasks 2-5B and 2-5C RIs identified the highest concentrations of TCL VOCs and SVOCs, and SVOC TICs upgradient of AOC FTA-2/LF-2 (E.C. Jordan Co., 1990a; ABB-ES, 1996a). The only VOCs detected in crossgradient or downgradient monitoring wells were toluene and xylenes at concentrations below CRQLs. The SVOCs BEHP and 4-methylphenol and fuel-related SVOC TICs were also detected at concentrations less than those found upgradient of the AOC. However, based on an evaluation of the fate and transport of detected contaminants, fuel-related contaminants in deep subsurface soil associated with FTA-2 have potential to affect groundwater quality. The inorganics cadmium,



chromium, arsenic, and lead were present in groundwater samples collected downgradient of AOC FTA-2/LF-2 and are commonly derived from landfilled materials. Cadmium (up to 10.6 µg/L) and lead (up to 16.8 µg/L) were detected at concentrations greater than their respective MCLs of 5 and 15 µg/L in monitoring wells downgradient of AOC FTA-2/LF-2. The RI report concluded, however, that these inorganics may have been released by reducing conditions in the aquifer, rather than by leaching from landfill materials at LF-2.

Separation of the effects on groundwater of former firefighter training activities, the burning of landfill wastes, and Western Aquafarm operations is difficult because of the proximity and similarity of the contaminant sources. Groundwater contamination at AOC FTA-2/LF-2 is discussed in detail in the Southeast Region Groundwater Operable Unit (SERGOU) RI report (ABB-ES, 1994).

Discussion of Remedial Objectives

For the 6 AOC's the following table summarizes the STCLs required to protect human health and groundwater quality for the groundwater contaminants of concern at this AOC.

Contaminants	STCL	Basis for selection
Ethylbenzene	700 µg/kg	Leaching-based
Total xylenes	10,000 µg/kg	Leaching-based
Chromium	6.8 mg/kg	Inside the flightline
Copper	19.3 mg/kg	Inside the flightline
Cyanide	1 mg/kg	Inside the flightline
Lead	15.8 mg/kg	Inside the flightline
Mercury	1.48 mg/kg	Inside the flightline
TPH	1,200 ppm	Inside the flightline
Zinc	16 mg/kg	Inside the flightline
Benzene	10 µg/kg	Leaching-based
Trichloroethene	10 µg/kg	Leaching-based

The STCLs are consistent with applicable or relevant and appropriate requirements (ARARs) for groundwater, attain USEPA's risk-management goal for remedial actions, and have been determined by the Air Force Center for Environmental Excellence (AFCEE), USEPA, and Massachusetts Department of Environmental Protection (MADEP) to be protective. These cleanup levels must be met at the completion of the remedial action at the limits of STCL excellence established during predesign confirmation soil sampling.

The selected remedy for the 6 AOCs is biosparging with ambient air monitoring. Collection and treatment of biosparging off-gas is not anticipated as part of this alternative; however, ambient air monitoring will be performed to confirm compliance with ARARs. Key components of this alternative include

- mobilization and site preparation;
- performing baseline ambient air monitoring;



- collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants ethylbenzene and total xylenes at the proposed cleanup location;
- performing a pilot-scale test of biosparging to obtain site-specific data for use during full-scale design;
- designing and installing a full-scale biosparging treatment system;
- collecting ambient air samples to assess compliance with ARARs;
- conducting quarterly performance monitoring in the form of soil sampling and analysis for carbon dioxide, oxygen, and the target compounds of ethylbenzene and total xylenes;
- operating and maintaining the biosparging system until cleanup criteria are met;
- maintaining institutional controls that restrict site access and limit potential human exposure to contaminants;
- filing a Record Notice of Landfill Operation with the Registry of Deeds to document the location of the landfill; and
- performing five-year site reviews.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed.

Regulatory concurrence of this final report is provided by the following authorities:

Frank Ciavattieri (for) Patricia L. Meaney
Director
Office of Site Remediation and Restoration
USEPA, New England

30 September 1998

Paul Taurasi, P.E. (in a separate letter)
Regional Director
Commonwealth of Massachusetts
Department of Environmental Protection

29 September 1998

Statement of the Continued Protection of Human Health and the Environment

The selected remedy for AOC FTA-2/LF-2 is consistent with CERCLA and, to the extent practicable, the National Contingency Plan (NCP). The selected remedy is protective of human health and the environment, attains ARARs, and is cost-effective. The statutory preference for treatment, which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances as a principal element, is satisfied. Additionally, the selected remedy utilizes alternative treatment technologies to the maximum extent practicable for this site.

The selected remedy for AOC FTA-2/LF-2 will permanently reduce the risks to human health and environment by eliminating, reducing, or controlling exposures to human and environmental



receptors through engineering and institutional controls. The principal threat at AOC FTA-2/LF-2 is leaching of organic chemicals from subsurface soil to groundwater. Engineering controls included in this alternative will reduce the concentration of subsurface soil contaminants, and institutional controls will restrict site access, resulting in reduced potential for human exposure to contaminated media.



APPENDIX E.8

Site Name: Landfill-1 Groundwater Operable Unit**Site Description**

LF-1 began operating in 1941 as the primary solid waste disposal facility at MMR. From the late 1940s until 1984, disposal activities were conducted by the U.S. Army, Air Force, Navy, Coast Guard, Air National Guard (ANG), U.S. Department of Agriculture Experiment Stations, and the Veterans Administration. From 1984 to 1989, ANG regulated disposal in the Post-1970 Cell as a component of the MMR Hazardous Waste Management Plan. Sanitary waste disposal ceased at the Post-1970 Cell and Kettle Hole Cell in 1989. Construction debris was added to the Kettle Hole Cell until 1990. Waste has since been sent to a transfer station on MMR, with final disposal at the SEMASS incinerator in Rochester, Massachusetts. Closure activities at the landfill, including capping three cells and instituting long-term groundwater monitoring, were completed in December 1995. Therefore, continued monitoring of natural attenuation will be conducted.

Waste was reportedly disposed of at the landfill in five distinct cells and a natural kettle hole. The cells are designated by the year representing the approximate last date of waste disposal, estimated by a review of historical aerial photographs. The five cells are 1947, 1951, 1957, 1970, and Post-1970. Wastes believed to have been disposed of at LF-1 include general refuse, fuel tank sludge, herbicides, solvents, transformer oils, fire extinguisher fluids, blank small-arms ammunition, paints, paint thinners, batteries, DDT powder, hospital waste, municipal sewage sludge, coal fly ash, and possibly live ordnance (ANG, 1992). During its active history, the MMR was home to as many as 80,000 military and aviation personnel whose municipal refuse was disposed of at the landfill. Recent subsurface investigations, as well as the existing surface topography at older cell areas, indicate that trench-and-fill methodology was used for landfilling. Refuse was buried in linear trenches and covered daily with soil excavated from the trench.

Investigations conducted at LF-1 resulted in an initial characterization and delineation of the groundwater contaminant plume associated with LF-1 (ABB, 1992). Chlorinated volatile organic compounds (VOCs), aromatic hydrocarbons, and inorganic constituents were detected in groundwater downgradient of LF-1; the highest concentrations and largest number of contaminants were associated with the Post-1970 cell. These compounds were also detected in groundwater immediately downgradient of the 1970 cell.

Groundwater data collected during 1989–90 (ANG, 1993) indicated that significant contamination was not emanating from the older cells (1947, 1951, and 1957). Therefore, landfill cover systems were constructed on only the remaining three cells (1970, Kettle Hole, and Post-1970). These cover systems are designed to prevent water from percolating through the landfill waste to minimize leachate. By reducing the amount of moisture present within the cells, the caps can also reduce the amount of biological activity present.

Each cover system comprises an impermeable cap built on top of the cell and an associated drainage system.



The LF-1 plume is approximately 17,000 feet long, 4,300 feet wide, and up to 100 feet thick. The toe of the plume separates into a northern and southern lobe. The primary VOCs constituents exceeding maximum contaminant levels (MCLs) in the plume are PCE, TCE, and carbon tetrachloride (CCl_4), each having MCL values of 5 $\mu\text{g/L}$. MCL exceedences of these three contaminants define the perimeter of the plume. Several other VOCs have also been detected in areas interior to the interpreted outer plume boundary.

The contamination in the northern lobe exists at two elevations. Shallow contamination (PCE and TCE) exists from approximately 10 to -100 feet mean sea level (msl) in wells east of Route 28. Deep contamination (primarily TCE) exists from approximately -120 to -180 feet msl in wells located primarily west of Route 28. This deep contamination exists immediately above bedrock. In the southern lobe, the contamination (PCE, TCE, and CCl_4) exists from approximately 10 feet to -130 feet msl. TCE and PCE have been detected at concentrations up to 120 $\mu\text{g/L}$ (27MW0031A) and 65 $\mu\text{g/L}$ (27MW0103A), respectively.

Discussion of Remedial Objectives

During 1997 the DCM process was used to evaluate several conceptual plume response alternatives in regard to effectiveness-, implementability-, and cost-related criteria. In December 1997, after considering the advantages and disadvantages of proposed plume response alternatives and weighing public comments, monitored natural attenuation (MNA) was selected as the appropriate action for the portion of the LF-1 plume west of Route 28. In addition, AFCEE decided to pursue a parallel track project for the eastern portion of the LF-1 plume. While the design of an ETR system would proceed for this portion of the plume, simultaneously a focused feasibility study (FFS) would be conducted to determine the appropriateness of MNA. Following the submittal of the FFS (July 1998) and FFS supplement (September 1998) and the subsequent public comment period, AFCEE, EPA, and MADEP have engaged in discussions regarding the appropriate action for the eastern portion of the plume. A final decision regarding the plume response action for the eastern portion of the plume is scheduled for December 8, 1998.

A document entitled *Plume Response Decision Criteria and Schedule*, dated 24 April 1997, describes the process that was used in evaluating and comparing LF-1 plume-response alternatives. The Plume Response Alternatives Evaluation Matrix, presented in the document, was used to summarize and compare plume response alternatives.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Implement the selected remedy as described. Alternative 3E is informally referred to as the "Warm-Spot" alternative. The Warm-Spot alternative is designed to achieve mass removal of a portion of the northern and southern plume lobes in areas of relatively high VOC concentrations. This objective would be accomplished by installing two focused ETR systems near the base boundary. By installing two small ETR systems near the base boundary, socioeconomic and ecological impacts associated with ETR system construction would be limited. This alternative is dependent on MNA to reduce contaminant mass and concentrations in the majority of the plume.



The system would be located near 27MW0105 and 27MW0108 in the southern and northern lobes, respectively. The reinjection fences will be located immediately downgradient of the extraction wells. Six extraction and four reinjection wells will be installed. The total pumping rate is estimated at approximately 1,200 gallons per minute (gpm) (1.7 million gallons per day). It is assumed that two wastewater treatment plants would be constructed on MMR property. The following lists the components of Alternative 3E, along with specific considerations for this alternative:

Warm-spot extraction fence

- Achieves mass removal in portions of the northern and southern plume lobes east of the base boundary in higher-concentration areas.

Warm-spot reinjection fence

- Returns treated water to the aquifer, balancing the effects of drawdown due to extraction.
- Treated water would be returned to the upper portion of the aquifer above the contaminated zone.

Statement of the Continued Protection of Human Health and the Environment

Based on the evaluation of plume stability and the results of solute fate and transport modeling, it appears that the LF-1 plume has reached steady-state equilibrium and is beginning to recede. Under this alternative, long-term risks will be reduced as the contaminant concentrations continue to decline over time due to natural attenuation. In addition, a very small amount of contaminant mass would be removed through groundwater extraction and treatment under this alternative compared to that already being removed by natural processes.

Construction of well fences associated with this alternative may alter the habitat of at least one (possibly several) rare species. While the impacts on long-term survivorship are unknown, it is expected that these impacts would not be unacceptably high and could be reduced through appropriate planning and restoration. If all construction activities are confined to the area directly adjacent to Route 28 or existing base roads, impacts would likely be minimal. Impacts are expected to increase if the construction area is moved away from the roadways and into less developed areas.

Because all ETR alternatives would require construction of a treatment plant(s) on base property, Alternative 3E would have additional ecological impacts caused by construction of influent and effluent well piping connecting the wellfields to the treatment plant(s).

The established hydrological thresholds are compared to drawdown with respect to the no-action and MNA alternatives.

Human health risks were estimated assuming the potentially completed exposure pathways are swimming in surface water bodies potentially contaminated by inflowing groundwater and working in the cranberry bogs near Route 28A containing potentially contaminated water.

Some residents in the vicinity of the LF-1 plume utilize private groundwater wells. Institutional controls would be required to prevent exposure to site contaminants through these existing wells



or any wells installed in the future. To compensate for the possible loss of use of this groundwater, the Air Force will provide hookups to public water supplies for users impacted by the LF-1 plume. The Air Force is replacing Bourne public wells two and five with safe, clean supplies to address any potential contamination issues.

Human health risks were calculated by JEG using input parameters and updated formulas presented in the MMR Risk Assessment Handbook and the Risk Assessment Guidance for Superfund. The primary risk drivers for the site are the contaminants PCE, TCE, and CCl_4 . Surface water concentrations of these contaminants were conservatively calculated utilizing the maximum contaminant concentrations previously detected in the LF-1 plume and assuming contaminants from the plume discharge to Long Pond and Herring Brook. It should be noted that this approach is conservative and that actual surface water contaminant concentrations and associated risks are expected to be much lower.

Ecological risks were estimated assuming that the only completed exposure pathway is in surface water bodies potentially contaminated by inflowing groundwater. Surface water concentrations of TCE, PCE, and CCl_4 were conservatively calculated utilizing the maximum contaminant concentrations previously detected in the LF-1 plume and the model-predicted contribution of contaminated water to surface water flux for each alternative. Model-predicted concentrations for Herring Brook were used for the risk calculations because they were higher and therefore more conservative than those estimated for the other surface water bodies.

Estimated surface water concentrations for TCE and PCE were several orders of magnitude below EPA ambient water quality criteria (AWQC). Therefore, the ecological hazard indices are well below 1.0. Estimated surface water concentrations for CCl_4 are more than an order of magnitude below the lowest HEC value. Therefore the ecological hazard indices are well below 1.0.

The highest groundwater concentrations for TCE, PCE, and CCl_4 ever observed in the LF-1 plume are well below the ecological benchmark values for surface water. Therefore, no adverse ecological impacts to surface water (including the ocean) are expected, regardless of the plume's contribution to surface water flux.



APPENDIX E.9

Site Name: Petroleum Fuel Storage Area/Fuel Spill-10/Fuel Spill-11

Site Description

The PFSA is an active fuel storage facility that has operated since the early 1950s (E.C. Jordan Co., 1986). The facility consists of three aboveground storage tanks, aboveground fuel distribution lines, pumphouses, and truck fill stands (Figure 5). The tanks vary in capacity from 0.5 to 1.2 million gallons. Each aboveground tank is surrounded by a containment berm made of native sand coated with asphalt. The ground within the berms consists of native sand and gravel. The area outside the berms is a combination of paved roadways and grassy areas. The PFSA serves or has served as the primary storage and distribution center for JP-4 jet fuel, aviation gas (AVGAS), motor gasoline (MOGAS), and No. 2 fuel oil for MMR.

The PFSA is located on the northern side of South Outer Road inside the flightline security area. Access to areas within the flightline area is controlled with fences and guard posts, and activities not related to aircraft operations are limited and strictly controlled. Fences around the flightline areas are inspected daily by base security. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal. Most of the AOC PFSA is surrounded by a second, inner, 7-foot-high chain-link security fence, further restricting access. The PFSA is adjacent to the southern end of the aircraft maintenance ramp and occupies approximately 5 acres of relatively flat terrain at the head of the SD-2 drainage swale. Runoff from the PFSA is collected by a storm sewer system that discharges to SD-2, located immediately southeast of the PFSA across South Outer Road. Floodplains, wetlands, and endangered species are not known to be present at AOC PFSA/FS-10/FS-11.

The RI report estimated the total volume of near-surface fuel-contaminated soil at Tanks 23 and 24 to be no more than 1,700 cubic yards (cy). This estimate was based on observations of soil discoloration and fuel odors. Maximum detected concentrations of near-surface soil contaminants include 6.4 mg/kg of naphthalene, 1.3 mg/kg of 2-methylnaphthalene, 11.0 mg/kg of chromium, 11.6 mg/kg of lead, and 18 mg/kg of zinc. Fuel-related contamination was not detected in surface soils at Tank 21 during the RI; however, fuel contamination may exist at the former location of the Tank 21 valve box.

Based on observations of soil discoloration and odor, the RI report estimated that a substantially larger volume (approximately 69,000 cy) of fuel-contaminated soil exists within the capillary-fringe/shallow groundwater beneath AOC PFSA/FS-10/FS-11. This contaminated zone is estimated at 4 to 5 acres in extent, with an average thickness of approximately 10 feet.

An estimated 1/8-inch of floating fuel free product was reported at the water table in monitoring well MW-316 in August 1995 (Aker, 1995). This thickness is at the lower limit of field instrument accuracy, and the true thickness of free product may be less. Free product was not measured at 11 other nearby monitoring wells. The National Guard Bureau (NGB) initiated a program to monitor free product at AOC PFSA/FS-10/FS-11; however, additional data had not been collected as of July 1998.



Groundwater beneath and downgradient of AOC PFSA/FS-10/FS-11 was contaminated by fuel-related compounds leaching from contaminated surface soils and sediments associated with French drains and the storm sewer catch basin. The primary source of groundwater contamination appears to be dissolution of entrained, residual fuel-related VOCs and SVOCs within the capillary fringe at the water table, nearly 50 feet bgs. Annual water table fluctuations of 2 to 5 feet likely exacerbate this process.

Dissolved inorganics were detected above drinking water MCLs and action levels in groundwater samples collected in 1989, 1990, and 1993 beneath AOC PFSA/FS-10/FS-11. In 1993, analysis of groundwater samples from AOC PFSA/PS-10/FS-11 for total inorganics showed concentrations below MCLs for the elements listed here with the exception of cadmium (up to 7.9

The SERGOU RI report concluded that biodegradation of the plume is evident. Groundwater sampling results strongly indicate that the plume attenuates to less than detection limits prior to reaching Johns Pond (ABB-ES, 1994). Pondwater samples and pondbed samples did not detect AOC PFSA/PS-10/FS-11 contaminants. This investigation indicated that the eastern edge of the AOC SD-5/FS-5 chlorinated solvent plume underlies the western part of the AOC PFSA/FS-10/FS-11 plume.

In the eastern part of AOC PFSA/FS-10/FS-11, near-surface soils associated with French drains and sediments associated with the catch basin of the storm sewer system contain potentially significant concentrations of TPH and metals, respectively. The major contaminants at the French drains are ethylbenzene (up to 26 mg/kg), total xylenes (up to 92 mg/kg), and naphthalene (up to 5.2 mg/kg). Additionally, the maximum concentration of TPH is 6.8 mg/kg. Sediments in the catch basin were removed as part of the DSRP. The French drains were removed as part of the Fuel Systems Upgrade and DSRP.

Major contaminants in the catch basin sample are chromium (10.2 mg/kg), lead (37.3 mg/kg), and zinc (45.1 mg/kg).

Discussion of Remedial Objectives

The selected remedy for AOC PFSA/PS-10/FS-11 is biosparging with off-gas collection and treatment. This alternative provides institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. The remedy does not include a management of migration component. Groundwater contamination beneath and downgradient of the AOC will be addressed as part of the Plume Response Plan.

Based upon data developed in the RI and the PRA and summarized in the feasibility study, remedial actions to address risk associated with possible exposure to source area soils at AOC PFSA/PS-10/PS-11 are not warranted because present and future risks are within or below USEPA's acceptable carcinogenic risk range or for noncarcinogens, generally below an HI of 1. However, available data suggest that source-area soils may be a source of release of VOCs to groundwater. Such a release could result in an unacceptable risk to those who drink groundwater



at or downgradient of the source area. Therefore, the STCLs established for the DSRP at MMR were used to estimate residual soil levels that will be protective of future groundwater quality. The following table summarizes the STCLs required to protect human health and groundwater quality for the groundwater contaminants of concern at this AOC.

Contaminants	STCL	Basis for selection
Ethylbenzene	700 µg/kg	Leaching-base
Total xylenes	10,000 µg/kg	Leaching-base

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed.

Statement of the Continued Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment, and attains ARARs, refer to appendix F.7 for 6 AOC information.



APPENDIX E.10

Site Name: Storm Drain-2/Fuel Spill-6/Fuel Spill-8

Site Description

AOC SD-2/FS-6/FS-8 consists of a storm drainage ditch (i.e., SD-2) that extends from the southern boundary of MMR at South Outer Road, south-southwest toward Ashumet Pond. Two 42-inch-diameter storm drains and an oil/water separator discharge to the upstream end of SD-2. The storm sewer system collects stormwater from approximately 80 acres of concrete and asphalt-paved surfaces, hangar nosedocks, and support buildings. AOC SD-2/FS-6/FS-8 lies primarily outside the flightline security area.

Investigations at AOC SD-2/FS-6/FS-8 detected site-related TCL SVOCs, pesticides, polychlorinated biphenyls (PCBs), and TAL inorganics in sediments (surface soils). Subsurface soil and groundwater sampling and analysis did not indicate site-related TCL VOC, SVOC, pesticide, PCB, or TAL inorganic contamination.

Collection of 18 sediment samples between 1986 and 1993 provided the following information relative to sediment contamination. TCL SVOC analysis detected 19 SVOCs in sediment samples collected from the upper three-quarters of the drainage ditch. SVOC concentrations were generally below the CRQL, with the exception of sample SD-6, which was collected from an oily layer not observed at the other sampling locations. Five pesticides were detected in the lower 200 feet of the drainage ditch, within the alluvial fan adjacent to Ashumet Pond. The source of these pesticides is likely the former cranberry bog, where earlier sampling detected one of the same compounds and which discharges to the same area as AOC SD-2/FS-6/FS-8. Pesticides were not detected in the upper portions of the drainage ditch. PCBs were detected at low concentrations in three of the 18 samples collected from the drainage ditch. The distribution of these samples suggests that low concentrations of PCB contamination exist over the length of the AOC.

Ten TAL inorganics were detected in sediments at concentrations above the MMR background concentrations for surface soils (ASG, 1994). Of these inorganics, lead (up to 56 times background) and zinc (up to eight times background) were detected at the highest concentrations relative to background concentrations. With the exception of lead and chromium, inorganic detections above background were within the upper three-quarters of the drainage ditch, in a pattern similar to the observed SVOC contamination.

Subsurface soil contamination was not detected above the water table in soil borings at AOC SD-2/FS-6/FS-8. Because contamination was not detected above the water table, it was concluded that traces of fuel-related VOCs and SVOCs detected below the water table did not result from infiltration of surface runoff at the AOC.

Because the SVOC, pesticide, PCB, and inorganic contaminants detected at AOC SD-2/FS-6/FS-8 are of low solubility and volatility, migration of contaminants is expected to be primarily by erosion and redeposition of contaminated sediments.



Groundwater at AOC SD-2/FS-6/FS-8 was sampled during three separate events: the Task 5 Mashpee groundwater study, the Task 2-3B SI, and the Task 2-5 RI. Samples collected during each event were analyzed for VOCs, SVOCs, TPH, and TAL inorganics. Groundwater sample analysis did not detect TCL VOCs or SVOCs above CRQLs or TAL inorganics above the contract-required detection limits (CRDLs). Fuel-related VOC and SVOC TICs were detected in groundwater samples at estimated concentrations up to 11 µg/L. The groundwater contamination is attributed to the presence of contaminant sources upgradient of AOC SD-2/FS-6/FS-8, namely AOC PFSA/FS-10/FS-11, and is addressed in the SERGOU RI report (ABB-ES, 1994).

Discussion of Remedial Objectives

Remedial objectives for the 6 AOC's are contained in appendix E.7.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed (See appendix E.7).

Statement of the Continued Protection of Human Health and the Environment

The selected remedy for AOC SD-2/FS-6/FS-8 as part of the 6 AOC's will permanently reduce the risks to human health and the environment by eliminating, reducing, or controlling exposures to human and environmental receptors through engineering controls. See appendix F.7.



APPENDIX E.11

Site Name: Storm Drain-3/Fire Training Area-3/Coal Yard-4

Site Description

AOC SD-3/FTA-3/CY-4 is located near the southeastern border of MMR in a moderately industrialized area on the eastern side of the runways, covering approximately 30 acres. The majority of the AOC is bordered by Granville Avenue on the west and the Air National Guard Ammunition Storage Area on the east (Figure 5). A small portion of SD-3 is located east of the ammunition storage area. The SD-3 storm-water drainage ditch receives runoff from this area and the eastern edge of the aircraft maintenance ramp, the former Central Heating Plant, and associated stockpiles of coal and surficial coal ash. FTA-3 was located in an area where construction debris and coal ash were disposed of after construction of the Central Heating Plant in 1955. AOC SD-3/FTA-3/CY-4 is located within the fenced flightline security area. Access to areas within the flightline area is controlled with fences and guard posts, and activities not related to aircraft operations are limited and strictly controlled. Fences around the flightline areas are inspected daily by base security. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal.

Between February and April of 1994, the NGB, with concurrence of USEPA and MADEP, excavated coal, coal ash, and potentially contaminated soils from CY-4 and FTA-3 for use as subgrade fill during final capping of the main base landfill LF-1. A total of 42,000 cy of material, representing the majority of coal and coal ash at CY-4, was excavated to depths of up to 15 feet. Additionally, soils at the FTA-3 location were also removed. This excavation was then backfilled with clean fill and covered with wood chips, restoring the land surface to approximately the original grade.

Investigations at AOC SD-3/FTA-3/CY-4 detected fuel and coal-related contamination in surface and subsurface soils, including VOCs (subsurface soils only) and several SVOCs, primarily PAHs. Low concentrations of pesticides and inorganics were also identified at the AOC. Sections 2.0, 5.0, and 6.0 of the RI report discuss soil contamination at AOC SD-3/FTA-3/CY-4 in detail. However, most of the soils represented by samples discussed in the RI were excavated and placed in the main base landfill in 1994.

Groundwater samples collected during the Mashpee Groundwater Study, the SI, and the RI indicated that groundwater beneath and downgradient of the AOC was affected by chlorinated solvent contamination, including TCE, PCE, toluene, and 1,1,1-trichloroethane. Data from the SERGOU RI and the Johns Pond Groundwater Underflow Study indicate that AOC SD-3/FTA-3/CY-4 is most likely not a source of this contamination (ABB-ES, 1994; E.C. Jordan Co., 1991). Data from multilevel monitoring well clusters downgradient of the AOC show that groundwater at the water table does not contain chlorinated solvents; they are present only lower in the aquifer. In addition, subsurface soil samples did not contain the compounds identified in groundwater. This information suggests that the Central Heating Plant leaching wells, spills from shops and hangars along the aircraft maintenance ramp, or possibly the solvent storage facilities



were the source of these compounds. The SERGOU RI report discusses groundwater contamination at AOC SD-3/FTA-3/CY-4 in detail (ABB-ES, 1994).

Investigations at AOC SD-3/FTA-3/CY-4 detected fuel- and coal-related contamination in sediments, including SVOCs and inorganics. Low concentrations of pesticides and PCBs were also detected (ABB-ES, 1996d).

Discussion of Remedial Objectives

The selected remedy and objectives for AOC SD-3/FTA-3/CY-4 is part of the 6 AOC's. See in appendix E.7.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed (appendix E.7).

Statement of the Continued Protection of Human Health and the Environment

The selected remedy for AOC SD-3/FTA-3/CY-4 is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, and attains ARARs. See appendix E.7 for details.



APPENDIX E.12

Site Name: Storm Drain-4**Site Description**

AOC SD-4 is a mostly wooded drainage basin located in the southeastern section of beginning within the flightline security area immediately east of Hangar 124 and extending approximately 3,500 feet south to Johns Pond (Figure 5). The head of the drainage way, located north of Reilly Road, is within the flightline security area, approximately 300 feet in length, and is relatively flat, grassy, and at the approximate elevation of the flightline area. Access to areas within the flightline area is controlled with fences and guard posts, and activities not related to aircraft operations are limited and strictly controlled. Fences around the flightline areas are inspected daily by base security. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal. The remainder of the drainage way, located south of Reilly Road, is outside of the flightline security area. The geomorphology of AOC SD-4 south of Reilly Road suggests a relic glacial melt-water drainage way located within hilly terrain. Because of the size of the AOC, it was divided into upgradient and downgradient areas. The upgradient area extends from the area east of Hangar 124 to approximately 300 feet southwest of the MMR boundary near groundwater monitoring well MW-515A and includes a low wetlands area and small pond. The downgradient area includes the drainage swale from MW-515A south to a former cranberry bog adjacent to Johns Pond.

Field observations and analytical results show that contamination of surface soils is limited primarily to the presence of low concentrations of SVOCs, pesticides, PCBs, inorganics, and TPH in the wetlands south of the unnamed upgradient pond at the confluence of the AOC SD-4 drainage ways.

Dieldrin, a breakdown product of the pesticide aidrin, appears to be ubiquitous in surface soils; it was also detected in surface water and sediment samples throughout the AOC SD-4 area. Dieldrin also appears at other AOCs at MMR (ABB-ES, 1993). The detection of this very persistent pesticide is attributed to past pest control practices at MMR. Similarly, 4,4'-DDT and its breakdown products are also found throughout AOC SD-4.

Detection of the PCB Aroclor-1260 was limited to surface soil, sediment, and surface water samples, suggesting that contamination is associated with surface water runoff, sediment transport, and deposition within the AOC SD-4 drainage way.

Although detectable concentrations of VOCs, SVOCs, pesticides, and TPH were present, significant contamination of subsurface soils was not identified. Chromium and iron were the only inorganics detected above MMR background concentrations. The fine-grained nature and organic content of the alluvial sediments and wetlands soils in the bottom of the drainage way may have sorbed contaminants, thereby mitigating large-scale vertical migration of contaminants from the surface to the deeper overburden.

Groundwater sampling conducted at AOC SD-4 showed minimal contamination. Concentrations



of analytes were below MCLs, with the following exceptions: (1) total lead was detected at 17.4 µg/L (total) in MW-1 (located in the drainage ditch north of Reilly Road), which exceeds the federal action level and state MCL of 15 µg/L; and (2) dissolved antimony was detected at 6.4 µg/L in the duplicate sample from MW-6 (located downgradient of former Building 123), which exceeded the state and federal MCL of 6 µg/L.

Discussion of Remedial Objectives

- The selected remedy for AOC SD-4, as part of the 6 AOC's is excavation and asphalt-batching. See appendix E.7 for details.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed.

Statement of the Continued Protection of Human Health and the Environment

The selected remedy for AOC SD-4 as part of the 6 AOC's is consistent with CERCLA. The selected remedy is protective of human health and the environment and attains ARARs. See appendix E.7 for details.



APPENDIX E.13

Site Name: Storm Drain-5 Source/Fuel Spill-5**Site Description**

AOC SD-5/FS-5 is located in the central part of the MMR cantonment area between North Inner Road and Lingley Avenue on the north and south, respectively, and Base Runway No. 5 on the east, approximately 3,000 feet from the southern MMR boundary (Figure 5). The AOC occupies approximately 40 acres at the northern end of a natural drainage swale that formerly extended southward for more than 10,000 feet toward Ashumet Pond. AOC SD-5/FS-5 extends approximately 2,000 feet along an unfilled portion of the drainage swale and varies in width from approximately 750 to 1,200 feet. AOC SD-5/FS-5 is within the flightline security area. Access to areas within the flightline area is controlled with fences and guard posts, and activities not related to aircraft operations are limited and strictly controlled. Fences around the flightline areas are inspected daily by base security. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal (Figure 5).

The SD-5/FS-5 drainage swale along the western side of the AOC has become overgrown with trees with small grassy areas interspersed. Floodplains and wetlands are not known to exist at AOC SD-5/FS-5, and endangered species are not known to reside there. The drainage swale is up to 25 feet below the grade of the flightline area.

The central drainage swale at AOC SD-5/FS-5 receives storm-water runoff from approximately 100 acres of paved runways and ramps through an extensive storm-water drainage system. The swale is unlined and water that does not evaporate or infiltrate, flows south to an unlined 1-acre storm-water infiltration basin. During extensive storm or runoff events, the storm-water infiltration basin overflows into two buried 72-inch-diameter pipelines, flows southward beneath AOC FTA-2/LF-2, and discharges to Study Area SD-1.

AOC SD-5/FS-5 is divided into the following three source-area operable units (OUs):

- SD-5A: the NDIL and the Corrosion Control Shop
- SD-5B: the Western Aquafarm, AVLUBE Barrel Storage Area, and Refueler Truck Park Area
- SD-5C: the Eastern Aquafarm, Permanent Field Training Site, Fuel Spill No. 5, and Central Drainage Swale

A fourth OU, SD-5D, was identified for groundwater and is discussed in the *Southeast Region Groundwater Operable Unit (SERGOU) Remedial Investigation (RI) Report (Including Region III)* (ABB-ES, 1994). The SERGOU RI report discusses groundwater contamination as it relates to several sources in the southeastern portion of MMR, including AOC SD-5/FS-5. Groundwater contamination attributed to AOC SD-5/FS-5 is being addressed by the SD-5 North Groundwater Plume Extraction, Treatment, and ReInjection System and the SD-5 South Recirculating Well System.



This subsection discusses soil contamination at the three source-area OUs at AOC SD-5.

SD-5A Operable Unit

Contamination within the SD-5A OU is present in surface and subsurface soils. Fuel odors and discolored soil were observed in the capillary-fringe zone near the NDIL leaching well.

SD-5B Operable Unit

Contamination within the SD-5B OU is present in surface and capillary-fringe zone soils. Inorganics and VOCs are the primary contaminants.

SD-5C Operable Unit

Contamination within the SD-5C OU is present in surface and subsurface soils. The surface soil contamination is primarily inorganics at concentrations above MMR background concentrations. In isolated areas, subsurface soil contamination is also present in the form of VOCs with the potential to leach to groundwater.

Discussion of Remedial Objectives

The selected remedy for AOC SD-5/FS-5 is excavation and asphalt-batching. This alternative provides institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. The remedy does not include a management of migration component. Groundwater contamination attributed to AOC SD-5/PS-5 is being addressed by the SD-5 North Groundwater Plume Extraction, Treatment, and Reinjection System and the proposed SD-5 South Recirculating Well System.

Further remedial objectives for this site, as part of the 6 AOC's can be found in appendix E.7.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

It is recommended that the selected remedy for FTA-2/LF-2, as proposed in *MMR Record of Decision, Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5 Source, Final, September 1998*, be implemented as proposed.

Statement of the Continued Protection of Human Health and the Environment

The selected remedy for AOC SD-5/FS-5, as part of the 6 AOC's is protective of human health and the environment and attains ARARs. See appendix E.7 for more details.



APPENDIX E.14

Site Name: Storm Drain-5 Groundwater Containment System**Site Description**

The source of the Storm Drain 5 (SD-5) groundwater plume is the SD-5 site, which received surface runoff from various military and industrial activities on the Massachusetts Military Reservation (MMR). Other sources include two underground fuel storage/transfer systems, the Non-Destructive Inspection Laboratory, the Corrosion Control Shop, and buildings on the western side of Runway No. 5 (Figure 5).

The proposed plan for “Six Areas of Contamination” includes a description of the Air Force’s preferred alternative for addressing the SD-5 source area. This proposed plan was released for public comment in November, 1997 and has been approved by the regulatory agencies. The Record of Decision is currently under regulatory review. The Air Force Center for Environmental Excellence’s (AFCEE’s) preferred alternative consists of excavating contaminated soils and mixing them with asphalt and gravel to hold the contaminants in place. The asphalt will then be used as a base of sub-base material for roads on the MMR.

The primary contaminants in the SD-5 plume are trichloroethene (TCE) and tetrachloroethene (PCE), both chlorinated solvents formerly used at the MMR. The northern part of the plume contains 1,2-dichloroethylene (1,2-DCE), another chlorinated solvent. The southern part of the plume does not contain 1,2-DCE, but the fuel additive ethylene dibromide (EDB), formerly used at the MMR, has been detected sporadically there. Maximum concentrations that have been detected are 43 parts per billion (ppb) for TCE, 5 ppb for PCE, 1 ppb for 1,2-DCE, and 0.12 micrograms per liter (µg/L) for EDB. The safe drinking water standards are 5 ppb for TCE, PCE, and 1,2-DCE, and 0.02 ppb for EDB.

The SD-5 groundwater plume is about 10,000 feet long, approximately 500 feet wide in the north and a maximum 1,000 feet wide in the south, and 20–100 feet thick. The southern part of the plume is about 4,500 feet long, a maximum 1,000 feet wide, and an average 50 feet thick.

The SD-5 South plume extends from the southeast base boundary toward Ashumet and Johns Ponds and extends beneath and into Johns Pond. The primary contaminants in the plume have not been detected in the surface waters of Ashumet or Johns Ponds.

An extraction, treatment, and reinjection (ETR) system was installed in the northern part of the groundwater plume. The system consists of 10 extraction wells and 8 reinjection wells near the MMR border and a treatment plant for the extracted water, all located on the base.

The ETR system draws the water out of the ground and removes the contamination by running the water through canisters of activated carbon. The carbon adsorbs (holds onto) the contaminants. Reinjection wells return the clean water to the aquifer. The carbon canisters are recycled off site. Construction began in February 1997, and the system began operation on August 4, 1997, 2 days ahead of the EPA deadline.



Groundwater flowing into and treated water flowing out of the plant is sampled weekly to ensure that the system continues to perform properly.

The southern part of the SD-5 plume was one of four plumes to undergo the “decision criteria” process in 1997, a public process that enabled the remedial project managers and the public to compare and evaluate cleanup alternatives.

In December 1997, after careful consideration of the advantages and disadvantages of each plume response alternative and comments received during the public comment period, the remedial project managers from AFCEE, the U.S. Environmental Protection Agency (EPA), and the Massachusetts Department of Environmental Protection (MADEP) decided on an alternative to treat the SD-5 South plume.

The selected alternative uses recirculating well technology to reduce the contaminant mass. Recirculating wells will be installed along Hooppole Road and within the body of the plume. The exact locations and number of wells and other refinements of the remedial system will be determined during engineering design. Maximum engineering flexibility will allow for good design using the most up-to-date technical information about the plume.

Discussion of Remedial Objectives

The SD-5 plume was initially addressed in *Final Record of Decision for Interim Action, Containment of Seven Groundwater Plumes at MMR, September 1995*. Subsequently, it was decided to divide the plume into two sections, SD-5 North and SD-5 South.

The action proposed for the SD-5 plume was to incrementally design and install a plume containment system, focusing on the northern portion of the SD-5 plume first (i.e., the portion north of the base boundary). It was noted by the Technical Review and Evaluation Team (TRET) that the design of the ETR system for SD-5N should be relatively straightforward because “...the plume is shallow, the groundwater flow directions are almost horizontal, and the hydrogeology is not complex.” (TRET, 1996). The potential impacts that an SD-5N ETR system could have on sensitive ecological areas (e.g., surface water bodies) were projected to be minimal because of the relatively large distance from the system to a sensitive area and the relatively low pumping rates required to capture the northern portion of the plume.

The criteria used to evaluate the design and subsequent performance of the plume containment system in conjunction with the more generally stated criteria developed by the TRET are as follows:

- Maximize capture of the SD-5N plume with emphasis on areas of high concentration.
- Minimize the impact of the treatment system on the flux of groundwater to Ashumet and Johns ponds.
- Minimize drawdown and mounding resulting from the extraction and reinjection of groundwater.
- Facilitate constructability and minimize the impact to existing land use areas.
- Minimize recirculation of treated water between injection to extraction wells.
- Minimize pumping rates.



These criteria were presented in the *Installation Restoration Program Plume Containment Design Groundwater Modeling Report* (ECE, 1996a).

TRET (1996) also provides guidance regarding the well layouts for the SD-5N ETR system. The extraction and injection fences (or recharge basins) should be positioned along South Outer Road where the SD-5 plume crosses the MMR boundary according to the TRET. The extraction fence should extend approximately 400 feet along South Outer Road. An injection fence (or series of recharge basins) should be installed downgradient and parallel to the extraction fence line.

The TRET recommended phased installation of an ETR containment fence for the northern part of the SD-5 plume. (The proposed system will intercept the plume approximately 2,500 feet north of Ashumet Pond.) Through an iterative process, a plume response strategy, which reduces toxicological risks while minimizing ecological impacts, should be developed. The hydrogeologic complexity between Ashumet and Johns Ponds may make containment or remediation of the southern part of the SD-5 plume problematic.

The actions proposed by the Air Force in response to the TRET recommendations include installation of a groundwater remediation system to intercept the SD-5 plume, as soon as possible, in the northern portion of the plume.

Objectives:

- Contain, capture, and remediate the northern portion of the SD-5 plume at the base boundary.
- Design, construct, operate, and monitor an ETR remedial system for the northern portion of the SD-5 plume.

This ETR system was installed in August 1997.

SD-5 South is one of the plumes that was subject to the remedial objectives defined in the balancing criteria of the Decision Criteria Document.

The revised design criteria are as follows:

- Avoid unacceptable toxicological risk from plume contaminants to human health and biological organisms.
- Avoid unacceptable impacts from the proposed containment strategy to the natural resources.
- Avoid undesirable impacts on regional groundwater flow and the paths and spreading of other plumes (TRET, 1996).

Subsequently, the TRET developed performance criteria related to ecological concerns for the entire MMR. The proposed performance criteria are as follows:

- 100% plume capture, with the plume defined by the maximum contaminant level.
- Less than 0.5 feet of drawdown or mounding of pond levels.



- Less than 0.2 feet of water-table change in sensitive ecological areas.
- Less than 20% change in groundwater flux through the ponds.
- Less than 25% of groundwater flux through the ponds may be injected water.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

In December 1997, in consultation with EPA and MADEP, AFCEE selected Alternative E, recirculating well technology, to address the SD-5 South groundwater plume. With extensive involvement by the community, Alternative E was chosen from a group of other possible alternatives as best balancing the selection criteria in the Decision Criteria Matrix (DCM).

One of the primary concerns driving cleanup of the SD-5 South plume was the possibility that a portion of the SD-5 plume underflows Johns Pond and could potentially impact downgradient water resources. At the time of the decision, computer modeling estimated that approximately 30% of the SD-5 plume underflows Johns Pond. The interaction of the SD-5 South plume and Johns Pond has also been the subject of discussion with TRET. Aside from shallow drive points obtained from the ecological assessment work reported in the *Ecological Studies, 1997 Annual Report* showing low levels of plume contaminants, little data existed that could define the hydrologic relationship between Johns Pond and the groundwater plume. Therefore, the decision for Alternative E included a plan to conduct data-gap analysis work, including an intensive data collection effort targeting aquifer zones directly beneath Johns Pond.

Based on the new analytical and hydrologic data from the data gap, the computer model was revised and recalibrated. Recent modeling runs on the recalibrated model calculate that less than 1% of the plume underflows Johns Pond, as opposed to the 30% previously estimated. The results of these studies provide a sound conceptual model of the plume-pond interaction. The excellent agreement in data among all the studies provides greater certainty that the entire SD-5 South groundwater plume does indeed upwell into Johns Pond.

Results of the data-gap studies have provided sufficient evidence that on upwelling into the pond, the SD-5 South groundwater plume disperses instantaneously to the point of being nondetectable. Therefore, contaminants do not pose a threat to human health. Furthermore, because the plume upwells into the pond, it is now evident that Mashpee's downgradient private well users and Mashpee's municipal water resources are not threatened by the plume. Residents in the Briarwood neighborhood are already on public water and are not exposed. The SD-5 North ETR system installed at the military base boundary to capture the northern portion of the SD-5 groundwater plume is effectively cutting off the plume. Based on the results of this evaluation, AFCEE feels that the decision to construct a recirculating well system to intercept and treat the plume in the Briarwood subdivision should be reconsidered.

AFCEE has proposed to build the two northern most axial wells on the current schedule. Discussions are ongoing on the subject of extending the future treatment system installation for SD-5.



Statement of the Continued Protection of Human Health and the Environment

In 1997, an ETR system was installed in the northern part of the SD-5 groundwater plume. The system consists of 10 extraction and 8 reinjection wells located on base near the MMR border and an on-base treatment plant for the extracted water. The ETR system draws the water out of the ground and removes the solvent contamination by running the water through activated carbon canisters. The carbon adsorbs the contaminants. Clean water is then returned to the groundwater by the reinjection wells. The carbon canisters are recycled off site periodically. The system began operation on August 4, 1997.

Sampling results from performance monitoring evaluations indicate that the ETR system for SD-5 North is cleaning up the plume. Preliminary results indicate that contaminants have been reduced downgradient of the ETR fences and that the system remains protective of human health and the environment.

To date, the results of the data-gap studies have provided evidence that on upwelling into the pond, the SD-5 South groundwater plume disperses instantaneously to the point of being nondetectable. Therefore, contaminants do not pose a threat to human health or the environment. However, investigations are continuing.



APPENDIX E.15

Site Name: Western Aquafarm (LTM only)

Site Description

The Western Aquafarm monitoring area is located in the southern portion of the MMR, generally west and southwest of the Otis ANG runways (Figure 5). This area is bounded by the Otis ANG aircraft runway and apron to the east and north, the Otis ANG-controlled area fence to the west, and Sandwich Road along the south.

The Western Aquafarm was used for the storage and transfer of aviation gasoline (AVGAS) and JP-4 jet fuel in the 1950s and 1960s. It formerly contained six 25,000-gallon underground storage tanks (USTs) for waste oils and fuels, an aboveground tank for kerosene, and aviation lubricant drum storage buildings (ABB-ES, 1994). By the 1970s, the use of the Western Aquafarm was discontinued, and in October of 1994, Western Aquafarm USTs and associated piping were removed (Envirocon Solutions, Inc., 1995).

Fuels used during fire training activities at FTA-2 and the burning of domestic waste during the operation of LF-2 are also possible contamination sources of the Western Aquafarm area (ABB-ES, 1994).

The primary contaminants in the Western Aquafarm monitoring area are fuel-related compounds: benzene, toluene, ethylbenzene, and total xylenes (BTEX), and to a minor degree, EDB and chlorinated solvents, including TCE, PCE, and cis-1,2-DCE. The Western Aquafarm plume configuration was mapped in the Installation Restoration Program (IRP) Plume Containment Data Gap Technical Memorandum (OpTech, 1996) as two isolated contaminant plumes with two different constituents. A BTEX plume was located in the northern portion near 39MW0002, and EDB was detected in well 00MW0574, located in the southern portion of the Western Aquafarm area.

Analytical results from earlier investigations (Table 2-2) were used to develop an analytical plan for the monitoring program. The highest frequency of VOC detections in the Western Aquafarm area are of BTEX compounds. The historical groundwater data indicates that MCLs were exceeded for benzene and ethylbenzene in one well, 39MW0002. In addition, the MCL for TCE was exceeded in one well, 28MW0018. Historical EDB analytical results were not confirmed by second-column (gas chromatography) analysis. Therefore, the historical reported values of EDB are suspect.

Discussion of Remedial Objectives

Through review of the nature and distribution of contaminants and the associated human health risks, it is recommended that the final objective of remediation of the Western Aquafarm plume will not be advanced under the current containment strategy of groundwater extraction and treatment (pump and treat). The following reasons are given:

- The Western Aquafarm plume has reached steady state and does not extend beyond the base boundary, where the proposed groundwater extraction system would be located.



- Current analytical data indicates that groundwater quality is not deteriorating in the Western Aquafarm plume and already meets cleanup criteria for almost all compounds throughout the extent of the plume.
- The human health risks are mitigated because there are no groundwater receptors, and therefore no completed exposure pathway, within the extent of contamination.
- The primary source of contamination has been removed.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

There is no conclusive analytical data that indicates groundwater contamination from the Western Aquafarm plume is migrating past the MMR base boundary. In addition, biological degradation is effectively containing the distribution of primary contaminants (fuel-related VOCs) to the same extent proposed by the extraction-and-treatment system. Therefore, it is not practical to use pump-and-treat technology to remediate groundwater, which already meets cleanup criteria for most compounds. The secondary contaminants (dissolved inorganic compounds) will naturally precipitate as DO levels rise to background concentrations.

It is recommended that periodic groundwater sampling for TAL and dissolved inorganic compounds, VOCs, SVOCs, and EDB be conducted on a yearly basis.

Statement of the Continued Protection of Human Health and the Environment

Quarterly groundwater monitoring indicated little change from historical contaminant concentrations within the Western Aquafarm area. The northernmost well (located within the FTA-2 source area and immediately downgradient of the former Western Aquafarm site) was the only well where MCLs were exceeded during the monitoring period. The MCL of 700 µg/L for ethylbenzene was exceeded for two of the three sampling rounds; concentrations ranged from 690 µg/L to 1,000 µg/L. The source of BTEX contamination is most likely from leaks or spills of petroleum products at the Western Aquafarm area and the use of fuels during fire training activities. BTEX concentrations at 39MW0002 have slightly decreased, and general increases in BTEX concentrations were observed in downgradient wells 39MW0004, 39MW0005A, 28MW0020, and 28MW0573. This is consistent with previously established trends and indicates that BTEX contamination is naturally degrading as it migrates downgradient.

EDB has not been detected in groundwater in any of the monitoring wells in the Western Aquafarm area during the second annual monitoring period. Although EDB is a significant contaminant of concern in some fuel plumes at MMR, analytical findings indicate that EDB is not a significant contaminant of concern in Western Aquafarm.

The site remains protective of human health and the environment. Monitoring will continue to ensure this.



Appendix F Sites in Progress Pending Records of Decision Requiring Remedial or Removal Action

List of Sites

F.1	*Chemical Spill-5 Former Refueler Maintenance Shop	F-1
F.2	Chemical Spill-10 UTES/BOMARC Site Source	F-7
F.3	*Chemical Spill-11 Former Pest Control Area	F-11
F.4	*Chemical Spill-15 Former Engine Run Up Area	F-3
F.5	Chemical Spill-16/Chemical Spill-17 STP Sludge Disposal	F-16
F.6	*Chemical Spill-16/Chemical Spill-17 DDOU	F-21
F.7	Fire Training Area-1 Current Fire Training Area (Source)	F-23
F.8	Fuel Spill-1 AVGAS Test Dump Site (Source and Plume Area)	F-27
F.9	*Fuel Spill-4 Current Product Tank 100/101	F-30
F.10	*Fuel Spill-7 Current Product Tank 115	F-33
F.11	Fuel Spill-9 Current Product Tank 108	F-37
F.12	*Fuel Spill-18 Fuel Transfer Point	F-41
F.13	*United States Coast Guard Chemical Spill-4 Hanger 28 Area/ United States Coast Guard Fuel Spill-1 Hanger 128 Fuel Spill	F-44

Priority 2 and 3 Study Area Sites. Note details of the remedial objectives, recommendations and Statements of Continued Protection of Human Health are contained in F.1. The remaining Priority 2 and 3 sites will reference back to this appendix.



APPENDIX F.1

Site Name: Chemical Spill-5 Former Refueler Maintenance Shop

Site Description

Study Area CS-5 is located at Building 3461 at the northeastern corner of Beaman and Weaver roads (Figure 6). From 1941 until 1946, Building 3461 was used by the U.S. Army as a weapons repair shop. Most of the study area is nearly level, with the majority of it covered by asphalt. A moderate slope was observed on the southwestern side of the study area, between the fence line and Weaver Road. Fences surround the area south of the building. Stained soil was observed south of the inner fence line during the field investigation.

Study Area CS-5 was evaluated as part of the MMR records search (E.C. Jordan Co., 1986a). According to the records search, a rust-inhibiting petroleum product called Cosmoline was routinely removed from new weapons, reportedly using gasoline and/or kerosene. Cosmoline and the compounds used to remove it were potentially disposed of at Study Area CS-5 (E.C. Jordan Co., 1986a). Based on results of the records search, the area was recommended for an SI.

The PA stated that from 1955 until 1967, the USAF used the area as a refueler maintenance shop and a spray paint shop. In addition to Cosmoline, waste oil, solvents, paints, battery acid, and antifreeze may have been disposed of on-site (E.C. Jordan Co., 1986a). During this time, 5,000-gallon refueler trucks were routinely emptied of up to 1,000 gallons of fuel, which was potentially disposed of on the ground at the study area. In addition, undocumented quantities of aviation gasoline (AVGAS) and jet fuel No. 4 (JP-4) were reportedly disposed of on the ground when filters were changed on the refueling trucks. The study area is believed to have been used as a salvage yard sometime during the period of operation. During the 1993 field investigation, Building 3461 was being used to store office furniture.

Two underground structures existed at the study area: an oil interceptor and a sump. A paint hood formerly located inside Building 3461 drained to an oil interceptor located outside the northwestern side of the building. The sump was located inside the building on the northern side and appears to discharge to a subsurface location outside the northern wall of the building. During the 1991 field investigation, two phases of liquid, an aqueous phase and an oil phase, were observed and sampled from the sump. No measurable liquid was observed in the oil interceptor. In 1996, as part of the DSRP, the oil interceptor and surrounding soil were removed, and the sump was decontaminated in place and filled with concrete. Closure reports documenting the clean closure of the structures are available at the IRP offices at MMR.

To identify potential risks associated with exposure to study-area-related CPCs, sitewide PRE and PRA calculations were conducted for surface and subsurface soil at Study Area CS-5 for both human health and ecological exposure scenarios. A detailed discussion of the PRE and PRA methodologies is in the RAH (ASG, 1994).

The PRA calculations indicate that estimated potential risks for current and future older child trespasser and utility worker exposure to maximum and mean COC concentrations in surface and subsurface soil at Study Area CS-5 do not exceed USEPA (10^{-4} to 10^{-6}) or MADEP (10^{-5}) risk-



management criteria. However, for the future residential scenario, estimated potential cancer risks are within the USEPA target risk range but exceed the MADEP cancer risk target for exposure to mean COC concentrations. Estimated potential noncancer risks associated with maximum COC concentrations slightly exceed the USEPA target HI. The majority of the potential estimated cancer and noncancer risks are attributable to Aroclor-1242, which was found at TP-4. Lead was not quantitatively evaluated; however, maximum and mean lead concentrations detected in soil at TP-15 significantly exceed the USEPA and MADEP lead guidance values.

The PRA calculations indicate potential surface-soil risks in excess of risk-management guidelines provided in the RAH for two ecological receptors, the white-footed mouse and the upland sandpiper. The majority of ecological risks are attributable to lead exposure through the food-chain ingestion pathway. A removal action was recommended for this site in the Priority 2 and 3 Study Area SI report (ABB-ES, 1993).

Discussion of Remedial Objectives

Comparison of contaminant concentrations identified at Study Area CS-5 to HECs showed that surface soil contaminated with Aroclor-1242 and lead may pose unacceptable risk to humans and ecological receptors. Elevated levels of petroleum hydrocarbons also are present in surface soil at this study area.

Removal action objectives were developed based on these considerations and were established to achieve the overall objective of protecting human health and the environment. With this primary objective in mind, the scope of the removal action is to provide for the complete removal of contaminants from the site (i.e., total site cleanup), such that unacceptable risks to human and ecological receptors are eliminated. AFCEE anticipates that these removal actions will be the final actions to remediate these study areas. As such, removal actions that will provide complete and irreversible contaminant removal are considered during alternative development. The alternative evaluations include a discussion of the effectiveness and permanence of the removal actions.

For the whole Priority 2 and 3 Study Area; The developed removal action objectives identify the responses necessary to achieve the scope of the removal actions, provide protection to human health and ecological receptors, and mitigate the potential groundwater impacts posed by contaminated soil.

In general, contaminant concentrations were compared to STCLs to determine the estimated extent of soil affected by site contaminants. Based on the existing analytical data, estimates of the horizontal extent and depth of soil removals were made for each study area. The final extent of removal will be determined based on the results of confirmation sampling and risk management decisions.

Removal action contracting activities will be conducted concurrently with the preparation of the Action Memorandum. The schedule for completion of the removal actions is dependent upon the alternative selected. The Removal Action Schedule is as follows:



EE/CA Public Comment Period	November 13–December 12, 1998
Submittal Draft Action Memorandum	February 15, 1999
Begin Removal Action Contracting	February 15, 1999
Submit Final Action Memorandum	March 17, 1999
Award Removal Action Contract	May 15, 1999

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

It is recommended that the preferred alternative be implemented as described for the 6 AOC's. Alternative 2 combines excavation, on-base asphalt batching, and/or off-base treatment and disposal of contaminated shallow soil from Study Areas CS-5, CS-11, FS- 18, CS-4 (USCG)/FS-1 (USCG), FS-7, and the DDOU. Additionally, a low-flow SVE system would be constructed at Study Area FS-4 to remove contaminants from deep subsurface soil, if necessary. This alternative includes the following major components:

- predesign activities;
- mobilization and site preparation;
- trench drain removal at Study Area CS-4 (USCG)/FS-1 (USCG);
- soil excavation, transportation, and stockpiling;
- on-base asphalt batching;
- off-base treatment and disposal;
- in-situ treatment at Study Area FS-4;
- site restoration; and
- wetlands restoration and monitoring.

Each component of the alternative is described in the following paragraphs.

The wetlands delineation at Study Area FS-18, predesign investigation at Study Area FS-4, and geophysical survey at the DDOU would be performed.

It is assumed that the on-site asphalt-batching facility would be located at FTA-1 on Kittredge Road, the former location of an on-base thermal desorption treatment unit. Locating the treatment facility here would minimize setup and permitting costs because the site is centrally located between the study areas, has an existing paved surface, available utility services, and controlled entry.

The trench drain associated with Hangar 128 would be investigated and removed, if necessary.

Excavation and confirmation sampling would be conducted. Because asphalt batching provides effective treatment of both organic and inorganic contaminants, there would be no need to stockpile soil from Study Areas CS-11, FS-18, CS-4 (USCG)/FS-1 (USCG), FS-7, and the DDOU separately for this alternative. Stockpile and decontamination areas for this alternative would be constructed in a manner similar to that for Alternative 1. An area would also be built for stockpile of treated material and would consist of a bermed asphalt pad. An estimated 2,500



cy of soil will require stockpiling; therefore, stockpile areas totaling approximately 2,500 square yards would be necessary.

Soil from Study Area CS-5 Areas 1 and 2 would be stockpiled at the study area and analyzed for concentrations of lead and PCBs. If sampling and analysis indicated lead concentrations less than 20 times the TCLP limit and PCB concentrations less than 2 mg/kg, the soil could be recycled through the on-base asphalt-batching system. The PCB limit for asphalt batching was determined with consideration of soil recycling permits issued by the MADEP Division of Hazardous Waste (M&E, 1995). An exceedence of 20 times the TCLP limit for lead would require the soil to receive TCLP analysis. Soil with concentrations less than the TCLP limit (i.e., 5 mg/L) would be processed in the on-base asphalt-batching unit. Soil exceeding the TCLP limit or 2 mg/kg PCBs would be sent off base for treatment and/or disposal in a permitted TSDF.

Asphalt batching is a method of stabilizing contaminants in soil using an ambient-temperature asphalt emulsion. The technology is referred to as soil recycling because the material is turned into an environmentally stable, structurally enhanced paving subgrade material. The technology has been applied to soil contaminated with petroleum hydrocarbons, VOCs, PAHs, PCBs, and metals. The process requires no external heat, thereby minimizing volatilization of contaminants. An asphalt-batching system has successfully operated at MMR for treatment of contaminated soil under the MMR DSRP.

Analytical results from stockpile samples would be used to confirm that excavated soil is acceptable for the asphalt-batching process. Collected samples would be analyzed for COCs listed for RCRA toxicity characteristic (40 CFR 261). For the purposes of cost estimation, one sample per 100 cy of stockpiled, excavated material is assumed; this frequency is typically required by asphalt-batching contractors. Samples with contaminant concentrations greater than 20 times TCLP regulatory levels would receive TCLP analysis. Soil with concentrations that exceed the Massachusetts Permitted Soil Recycling Facility Summary Levels, Massachusetts Method 1 S-1 standards for pesticides or TCLP criteria would not be treated on-base but would be transported to an off-base, permitted TSDF for treatment and/or disposal. Soil with concentrations below the above criteria would be processed in the asphalt-batching facility.

Following characterization sampling, soil meeting asphalt-batching and analytical standards would be screened, as necessary, to remove oversized objects larger than approximately three-quarters of an inch. Oversized material would be crushed to less than three-quarters of an inch and used as aggregate material in the asphalt-batching process to provide a structurally suitable asphalt product. For cost estimation, it is assumed 20 percent of excavated material will be greater than three-quarters of an inch in diameter and require crushing prior to processing.

Excavated soil and crushed material would then be processed. Asphalt-batching involves the addition of an asphalt-emulsion coating to contaminated soil. A front-end loader feeds soil into a hopper, from which it is transported to a mixing chamber via a conveyor belt. The soil passes through a series of counter-rotating blades, where the emulsion is applied. The asphalt-emulsion-coated soil exits the system and is stockpiled for curing for approximately 72 hours. During the curing process, the asphalt-emulsion-coated product binds the contaminants to the soil, which becomes structurally enhanced and can be stockpiled for several months prior to use. Stability of



the material would be verified with appropriate testing methods prior to reuse. The asphalt-emulsion-stabilized material then would be utilized as a paving subgrade material for paving projects at MMR. The recycled material would be covered with a 1-1/2-inch layer of surface-wearing coarse asphalt to prevent surface wear and potential reintroduction of contaminants into the environment via airborne particulates.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative for the priority 2 and 3 Study Areas will meet removal action objectives and provide protection of human health and the environment at the study areas. On-base asphalt batching would bind organic and inorganic contaminants to soil in an asphalt emulsion, thereby permanently reducing the mobility of contaminants. No change in contaminant toxicity is anticipated, and the volume of contaminated soil may increase slightly due to the addition of mixing materials and emulsion during the process. No contamination would be destroyed. Off-base treatment and/or disposal in an approved, secure landfill would reduce contaminant exposure potential and provide a reduction in contaminant mobility. Landfilling is a widely recognized and accepted containment technology.

A low-flow SVE system will reduce concentrations of contaminants in subsurface soil at Study Area FS-4 to below STCLs, thereby providing long-term effectiveness and protection of human health.



APPENDIX F.2

Site Name: Chemical Spill-10 UTES/BOMARC Site Source

Site Description

The Chemical Spill No. 10 and Fuel Spill No. 24 site (CS-10/FS-24) is next to the eastern boundary of Massachusetts Military Reservation (MMR) in the Town of Sandwich, Massachusetts, immediately north of the MMR Sandwich Gate on Greenway Road (Figure 6). Most of the 38-acre site is fenced and consists of a number of buildings originally constructed as part of the Boeing Michigan Aerospace Research Center (BOMARC), a missile launcher and maintenance facility operated by the U. S. Air Force (USAF). The facility is currently used by the Army National Guard (ARNG) as a storage site for training equipment. Three areas of CS-10/FS-24 are located outside the fenced portion of the facility: the waste oil disposal site to the north and two storm sewer drainage facilities to the south and east. The following items summarize the history of CS-10/FS-24.

- Before 1956. CS- 10 was occupied by a rifle range.
- 1958. Construction of the BOMARC missile site began.
- 1960 to 1973. USAF operated the BOMARC site until 1973, when the facility was decommissioned and transferred from USAF to ARNG control. Waste materials related to site operations and maintenance included cleaning solvents and fuel-related compounds associated with missiles, power supply, and heat generation.
- 1978 to present. In 1978, the ARNG began limited use of abandoned buildings for equipment maintenance and storage. The site also is used for vehicle maintenance. Motor oil, hydraulic fluid, battery electrolyte, cleaners, paints, and paint removers have been used on-site during this period.
- 1985. Several underground storage tanks were removed at CS-10 and backfilled with clean sand. FS-24, a fuel spill of less than 500 gallons, occurred during tank removal at Building 4606; contaminated soils were removed and backfilled with clean sand.
- 1985 and 1986. Monitoring wells were installed and groundwater contamination was detected at CS-10.
- 1989. A site investigation (SI) was performed to assess the presence of contamination in soils, sediment, groundwater.
- 1989 and 1990. An interim remedial investigation (RI) was performed to further assess the nature and distribution of contamination in various media.
- 1990 and 1993. Source control actions were taken to eliminate potential sources at CS-10. These included the cleaning of oil interceptors and removal of above- and belowground storage tanks.
- 1992 and 1993. A final RI was performed to further characterize contamination and to evaluate potential site risks. Nine source areas were identified that warrant cleanup actions.
- 1996. Inactive sumps and associated contaminated soils were removed under the MMR Drainage Structure Removal Program (DSRP).
- 1996. A supplemental field investigation was performed to fill data gaps in the evaluation of treatment technologies for source cleanup at the nine locations.
- 1996 and 1997. A focused feasibility study was performed to evaluate alternatives for controlling potential site risks. This study provides the detailed basis for this Proposed Plan.



- 1998. Supplemental sampling for asbestos, radiological surveying, and explosives testing were conducted to ensure the protection of human health and adequacy of the proposed remedial alternative. No explosive constituents were found above the reporting limit in any of the subsurface soil samples.

Groundwater contamination associated with CS-10/FS-24 will be addressed in separate studies under the Plume Response Plan. In addition, the actions proposed in this proposed plan will help minimize groundwater contamination and may reduce future groundwater treatment requirements.

Other source remediation efforts at CS-10/FS-24, which included drainage structure removal, have been addressed separately from this proposed plan under the DSRP. The DSRP involves a systematic, basewide investigation and cleanup effort to address drainage sumps that were used historically at MMR, including those at CS-10/FS-24.

Removal activities conducted under the DSRP are described more completely in the *Drainage Structure Removal Program Remedial Action Workplan* (Jacobs Engineering Group [JEG], 1995). Under the DSRP in 1996, 15 drainage structures and surrounding soils were removed; two drainage structures were cleaned and filled with concrete at CS-10. In addition to the drainage structures, a total of 31,550 gallons of liquids was removed from the structures and treated at an off-base industrial wastewater treatment facility, and 702 cubic yards (cy) of contaminated soils was removed and sent to an on-site asphalt-batching facility. Three additional drainage structures were not removed at CS-10 because of access restrictions. AFCEE plans to perform an investigation and sampling of structures not addressed under the DSRP prior to issuance of the Record of Decision (ROD) and, if necessary, to address potential source area remediation. The DSRP activities are summarized in the *Drainage Structure Removal Program Remedial Action Summary Report* (ABB-ES, 1998) currently under regulatory review.

The selected remedial choice in the *Draft Final Proposed Plan to Clean Up Source Operable Unit at Chemical Spill No. 10 (CS-10) and Fuel Spill 24 (FS-24) Site, August 1998* is currently undergoing regulatory review.

Discussion of Remedial Objectives

Investigations at the nine source areas of CS-10/FS-24 detected a variety of inorganic and organic contaminants in the soils and sediments. These contaminants are associated with the use of fuels, solvents, and other historical site-related activities at CS-10/FS-24. The results of the risk assessment for CS-10/FS-24 vary according to the conditions and site contaminants found at the source areas.

Human health risks from exposure to soil do not exceed federal and state risk management guidelines. However, based on the ecological risk assessment, surface soils at these source areas pose an unacceptable risk from metals (antimony, arsenic, cadmium, chromium, copper, lead, vanadium, and zinc), dieldrin, and/or polynuclear aromatic hydrocarbons (PAHs).

Groundwater beneath and downgradient of CS-10/FS-24 is contaminated with solvent-related



organic compounds. Following an extensive public decision process, a decision was announced in August 1997 on how the CS-10 groundwater plume will be treated. The Sandwich Road Fence treatment system startup is scheduled to begin June 1999.

Actual or threatened releases of hazardous substances from CS-10/FS-24, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to public health, welfare, or the environment.

Cleanup goals established for soil at CS- 10/FS-24 are STCLs. These levels are MMR-specific, risk-based and leaching-based concentrations protective of human health and the environment. STCLs were developed during the MMR DSRP. The RI for CS-10/FS-24 identified contaminants that pose unacceptable risk to human and ecological receptors from potential exposure to shallow soils, surface water, and sediment. These contaminants were compared to risk-based STCLs to determine the extent to which an area must be remediated. The concentrations of contaminants found in deeper soils with the potential to leach to groundwater were compared to leaching-based STCLs to identify where cleanup is required to prevent future contaminant migration to groundwater.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Implemented the selected remedy as proposed. AFCEE's preferred alternative for CS-10/FS-24 is Alternative 3, Excavation and On-Site Asphalt Batching/In Situ Thermally Enhanced SVE/Environmental Monitoring. The excavation and on-site asphalt batching addresses the cleanup of shallow soils at seven of the nine source areas; the in situ thermally enhanced soil-vapor extraction (SVE) addresses cleanup of deeper soils at one of the nine source areas; and the environmental monitoring occurs at two of the nine source areas where soil contaminant concentrations are very low and remediation is unwarranted.

A total of approximately 3400 cy of soil and sediment would be removed at seven of the source areas at CS-10/FS-24 (Details A, B, C, D, E, F, and I). The soils and sediment would be stockpiled, covered to eliminate contaminant migration, and processed in a cold-mix asphalt batch plant set up on site. Batched asphalt would be used at MMR and coordinated with similar cleanup efforts at other MMR sites. An underground storage tank (UST) and associated piping at Detail C would be removed during this phase of cleanup. Confirmation sampling would be conducted during the excavation process to ensure the limits of contaminated soil are met. The excavations would then be backfilled with clean material, and wetland areas at Detail F would be restored as appropriate under Massachusetts regulations. Because contaminated soil will be removed from this site and the preferred alternative does not include site access restrictions. Confirmation sampling and laboratory analysis of sediment will be conducted prior to issuance of the ROD.

If soils contamination the Detail C source area require treatment, the preferred alternative for cleanup of these would involve the installation of hot air injection wells, extraction wells, a vapor collection system, and a temporary impermeable cover. A mobile, thermally enhanced



SVE system consisting of an air blower/burner to inject hot air and off-gas treatment system would be set up to remove and treat organic compounds. Periodic air monitoring will occur to ensure the effectiveness of the off-gas treatment system in eliminating contaminants from the treated air stream. Confirmation sampling of deep soils would be performed to insure cleanup goals are met.

The preferred alternative for Details G and H involves additional subsurface soil samples and laboratory analysis to ensure that contaminant concentrations are below cleanup goals. The relatively low concentrations of contaminants in subsurface soils at those source areas indicate that the risk to human health and the environment are within the acceptable range.

Statement of the Continued Protection of Human Health and the Environment

The selected remedial alternative provides adequate protection for human health by preventing ingestion of surface soils and leaching of contaminants to the groundwater. This alternative is fully protective of the environment by removal of the contaminated surface soils, sediments, and surface water.



APPENDIX F.3

Site Name: Chemical Spill-11 Former Pest Control Area

Site Description

Study Area CS-11 consists of Building 1116, formerly used as the ANG and ARNG pest-control storage and mixing area (Figure 6). During the SI, the study area was nearly level, with no significant topographic features. An asphalt pad was present immediately east of the building, and the areas immediately north, west, and south were grassed. South of MW-1, the study area was lightly wooded, with grass 1–2 feet high.

This study area was identified in the MMR records search as an area of potential contamination (E.C. Jordan Co., 1986a). According to the records search, from 1970 to 1983, pesticides and herbicides were mixed on an unbermed asphalt pad located on the eastern side of the building (E.C. Jordan Co., 1986a). Reportedly, pesticides that spilled while being mixed were washed off the edge of the pad onto the surrounding soil. No major pesticide spills were reported, and pesticides are not currently stored at Study Area CS-11.

In 1983, when the pesticide shop was closed, approximately 200 pounds of pesticides were removed from Building 1116, including traditional chlorinated compounds such as Lindane and more modern organophosphorus pesticides such as Malathion and Sevin. No documentation was found that other pesticides such as 4,4'-DDT and dieldrin were stored in Building 1116; however, they were detected in soil surrounding the building.

The primary contaminants potentially released at Study Area CS-11 are pesticides and herbicides from spills during the historical handling and mixing of these solutions. A summary of the nature and distribution of contaminants detected during the SI, focusing on soil, is presented in this subsection. Contaminants of potential concern (CPCs) based on analytical data for surface soil. Additional discussions of Study Area CS-11 are in the Priority 2 and 3 Study Areas SI report (ABB-ES, 1993).

VOCs, SVOCs, pesticides and PCBs, and organophosphorus pesticides were not detected in groundwater samples collected from MW-1 during the three rounds of sampling. Inorganic analytes were not detected above MMR background concentrations.

To identify potential risks associated with exposures to study-area-related CPCs, a sitewide preliminary risk evaluation (PRE) was conducted for surface soil at Study Area CS-11, including both human health and ecological exposure scenarios. The PRE indicates that concentrations of dieldrin, arsenic, and beryllium in surface soil at Study Area CS-11 could cause unacceptable potential risks for future human residents. However, the maximum concentrations of beryllium (0.711 mg/kg) and arsenic (5.6 mg/kg) identified at TP-3, are only slightly above MMR background (0.65 mg/kg and 3.6 mg/kg respectively) but below the range observed in sandy soil. Therefore, any potential risks associated with beryllium and arsenic are mostly or all attributable to background concentrations.



Evaluation of ecological exposure scenarios conclude that concentrations of dieldrin, cadmium, chromium, cyanide, lead, and zinc exceed ecological receptor hazard equivalent concentrations (HECs) for Tier I assessments. In addition, concentrations of dieldrin and several inorganics result in a hazard index (HI) in excess of 1.

Discussion of Remedial Objectives

A removal action was recommended for this study area as a result of information collected during the Priority 2 and 3 Study Areas SI report (ABB-ES, 1993). A more detailed description of remedial objectives is contained in Appendix F.1.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

It is recommended that the selected remedy for Priority 2 and 3 study areas be implemented as proposed. See appendix F.1 for detail.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the study areas. See appendix F.1 Statement of the continued protection of human health and the environment for detail.



APPENDIX F.4

Site Name: Chemical Spill-15 Former Engine Run Up Area

Site Description:

Study Area (SA) CS-15, a former jet engine testing site, is located on the southeast side of MMR, on Riley Street (Figure 6). This SA consists of Building 202, which is an outside testing stand, Building 204, an enclosed testing stand, and the area surrounding these buildings. The SA was used for engine testing from 1949 until 1985, and during the SI, it was abandoned.

The site had a chain-link fence gate to restrict vehicle access. The areas immediately surrounding the paved portion of the SA were grass covered with woods beyond the grass. Grass was sparse around the former engine-testing pad, however, no staining was apparent. The cleared portion of the site was nearly level and the ground surface sloped to the southeast along the east and south tree line.

CS-15 was evaluated as part of the Task 6 Records Search (E.C. Jordan Co., 1986a). According to the record search, engines were tested inside Building 204 from 1949 to 1954. Wastes generated during this time were washed to a floor drain that led to a gasoline trap outside the eastern side of Building 204. After passing through the gas trap, effluent passed through an underground pipe to an open ditch, southeast of the SA. Flow from this ditch appeared to slow near Riley Street. It appeared that flow that did not percolate into the soil would move into a culvert under Riley Street, and would continue to an open intermittent drainageway south of the road.

From 1954 to 1985, engine testing was performed outside at "Building 202," which is a steel frame designed to hold the engines while being tested. It was estimated that from 1949 to 1970, 180 gallons per year of JP-4 and AVGAS, and 1,000 to 15,000 gallons per year of petroleum distillate (PD-680), were generated as waste (E.C. Jordan Co., 1986a).

From 1954 to 1970, wastes were washed off a concrete test pad and onto the ground. After 1970, the only waste generated was JP-4, which was picked up for disposal by an outside contractor (E.C. Jordan Co., 1986a).

A secondary source of potential contamination not identified in the record search at the SA, were three hanging transformers west of Building 204. These transformers were observed and identified as possible additional sources of contamination during the SI field program because stained soil was observed below the transformers. The area of stained soil was approximately 6 feet by 8 feet.

During Phase 3 of the field investigation, approximately 40, 55-gallon drums were observed on the former engine-testing pad. Many appeared to be full and some were labeled as engine lubricant and hydraulic oil. There were also seven empty USTs that appeared to have been removed from other locations. The rear door of Building 204 was open and several small containers of paint, oil, and other products were observed. An 8-foot by approximately 25-foot



tank was also observed in Building 204; its contents, if any, are unknown. These drums and USTS, although stored on-site, are not considered part of SA CS-15 and, therefore, were not sampled.

A report titled *Priority 2 and 3 Study Areas, Site Investigation, MMR, October 1993* (HAZWRAP) describes explorations conducted at the SA and discusses the rationale for exploration locations. A summary of soil sampling and monitoring well completion details is also presented. In addition, samples collected for on-site chemical screening and off-site laboratory analysis are summarized.

Discussion of Remedial Objectives:

Based on the past uses of CS-15, fuels and solvents may have been spilled and released at the SA during engine testing. In addition, oil-containing PCBs from overheated transformers may have leaked. The remedial objective of further site investigations were to provide an exploration program including test pits, monitoring wells, analytical results, hydrogeological investigations and a preliminary risk evaluation to determine what further actions may be necessary.

Areas of Non Compliance:

There are no areas of non-compliance.

Recommendations:

Based on the limited habitat at the site, as well as the relatively small areas of contaminated soil, no further action is recommended contingent upon the SRIP investigation of the gas trap.

Dieldrin soil HEC exceedances should be addressed as part of a MMR base-wide program

The data collected during the SRIP activities on the gas trap should be evaluated in combination with this SI data. The recommended disposition of the site should be based on the results of this evaluation.

Statement of Continued Protection of Human Health and the Environment:

In the drainage course leading from the gas trap, PCBs were detected at concentrations in excess of soil ecological HECS. In addition, detected concentrations of mercury, cadmium, lead, copper, and zinc also were in excess of soil ecological HECs in samples from this area. Copper and zinc were also detected at MW-2 in concentrations in excess of soil ecological HECS. In addition, humans and ecological receptors may also be exposed to unacceptable concentrations of PAHs if exposed to soil below the former suspended transformers. The concentration of three PAHs detected in stained soil below the former suspended transformer exceeded human health soil HECs and concentrations of several PAHs exceeded ecological HECs for indicator species. However, the observed concentrations of many PAHs were below the concentrations documented to occur in urban soil.

Based on the results of the PRE, ecological receptors may be exposed to concentrations of contaminants that may pose an unacceptable risk in two areas of the site, however, the limited habitat and the small area that has been impacted indicates minimal exposure will likely occur.



APPENDIX F.5

Site Name: Chemical Spill-16/Chemical Spill-17 STP Sludge Disposal

Site Description

Areas of contamination (AOCs) CS-16 and CS-17 occupy approximately 80 acres along the southern MMR boundary near the Falmouth gate (Figure 6). The site is situated in the southeast portion of the cantonment area of MMR. The closest on-base housing is located approximately 1.2 miles to the west. The closest off-base housing is located east of Sandwich Road, approximately 500 feet from the AOCs. These areas consist of infiltration sand filter and sludge drying beds located adjacent to the former MMR sewage treatment plant (STP). The STP disposed of treated effluent by discharging it to these sand filter beds. In the past, waste battery electrolyte, cleaners, solvents, and paint thinners from various operations at MMR are believed to have been discharged to the sanitary sewer system. It is expected that metals and organic chemicals contained in these waste materials partitioned to organic matter and concentrated in the treatment system sludges (HAZWRAP, 1994b). The former STP was being dismantled and salvaged during the RI. Demolition of the former STP was completed in 1997. None of the sand filter beds or sludge drying beds at AOCs CS-16/CS-17 are being used. A new STP is located north of the former STP. Treated effluent is pumped to filter beds near the Cape Cod Canal.

AOC CS-17 includes the following operable units:

- **Abandoned sludge drying beds:** Six abandoned sludge drying beds are located east of the STP. Each bed has an area of approximately 50 square feet and is separated from the adjacent bed by a rotted wooden plank barrier approximately 1 foot high.
- **Drum disposal area:** This area is located immediately north of the former sewage sludge drying area.
- **Former sewage sludge disposal area:** This is a 3- to 4-acre area southeast of the former STP characterized by numerous, nearly continuous mounds resembling what would remain after material was dumped from a dump truck. Two suspected sludge piles were identified in the pine wooded area. The first pile was approximately 40 by 20 feet in size and 1.7 feet deep.

The Ashumet Valley plume originates at the former Fire Fighter Training Area I (FTA-1), with contribution from the decommissioned MMR STP (CS-16/CS-17) about 1,000 feet to the south. Treatment of contaminated soils at FTA-1 began in June 1995 and was completed in September 1997. A total of 47,172 tons of soil was treated using a thermal treatment process. Soil cleanup objectives were met, the area was restored, and the source area no longer contributes to the Ashumet Valley groundwater plume. Activities to address soil contamination at CS-16/CS-17 are discussed in the following paragraphs. Groundwater contamination associated with the CS-16/CS-17 site is being addressed as part of separate studies under the Plume Response Plan.

AFCEE activities at CS-16/CS-17 carried out under the Installation Restoration Program (IRP) include performing an RI to characterize the nature and extent of contamination. Risk assessments were conducted as part of the RI to identify potential risks to human health and the



environment. The risk assessments evaluated the present and future risks to human and environmental receptors that may contact contamination under current conditions, assuming no remedial action is taken. Cancer and noncancer risks were evaluated. Additional activities included preparation of a feasibility study (FS) to identify and evaluate a range of remedial alternatives.

The proposed plan (August 1998) summarizes the RI and FS and presents remedial alternatives proposed for soil cleanup at three source areas at CS-16/CS-17. After careful consideration of several alternatives, AFCEE believes the proposed actions composing the AFCEE preferred alternative will protect human health and the environment and will comply with applicable environmental laws and regulations. The proposed plan, which is based on the FS, describes various remedial alternatives and the AFCEE preferred alternative. The Proposed Plan was approved in late Fall of 1998. The Draft Final Record of Decision is currently undergoing review.

Discussion of Remedial Objectives

Risk-based cleanup goals were established to support the development of remedial alternatives that will mitigate potential risks associated with AOCs CS-16/CS-17. The risk-based cleanup goals are based on the preliminary risk assessment (PRA) conducted during the RI by ABB. The conclusions of the PRA were the basis for estimating cleanup goals.

STCLs are MMR-specific risk-based concentrations that were developed for protection of human health and the environment for areas inside the flightline and outside. STCLs for areas outside the flightline would be appropriate for these AOCs. Because no unacceptable risk was posed by maximum concentrations in the human health risk assessment, STCLs were revised to include only the ecological risk component.

The remedial action objectives (RAOs) identified were the protection of ecological receptors by preventing bioaccumulation of identified COCs and the reduction of methylene chloride concentrations to levels not likely to cause risk if leached to groundwater.

The following response objective was identified for AOCs CS-16/CS-17.

- Reduce exposure of ecological receptors to COCs in the active sludge beds, inactive sludge beds, and former sludge disposal area surface soil that result in unacceptable risk.
- Reduce detected concentrations of methylene chloride to levels not likely to cause risk if leached into groundwater.

Guidance for the use of MMR STCLs require the following (HAZWRAP 1996):

- The maximum detected concentration of contaminants identified as posing unacceptable risk in the PRAs was compared to chemical-specific STCLs for outside the flightline (considering ecological receptor exposure to 0–2 feet bgs). AOCs where these contaminants were detected in maximum concentrations exceeding STCLs were identified as requiring response actions to achieve the response objectives.



- Maximum detected concentrations of leachable organic compounds (K_{oc} less than 1,000) were compared to STCLs. AOCs where leachable organic compounds were detected in concentrations exceeding the corresponding STCLs were identified as requiring response actions.
- Maximum detected concentrations of TPH were compared to the STCL for TPH outside the flightline (500 mg/kg). There were no AOCs where TPH was detected in concentrations exceeding the STCL.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Recommend implementing the selected remedy. The selected alternative involves the removal of surface soil with concentrations of COCs exceeding STCLs, on-site treatment by asphalt batching, and using the asphalt as subgrade paving for roads and parking areas at other MMR locations. This alternative will reduce potential ecological risks and minimize the potential impact of leachable COCs on groundwater. Soil samples collected from AOCs CS-16/CS-17 indicated the presence of sand, silt and sludge. Asphalt batching of this type of contaminated material will produce a nonleachable, cohesive material. Asphalt-batching will dilute the presence of silt and sludge found in the contaminated surface soil with large quantities of aggregate before incorporating this contaminated material into asphalt.

Implementation of the asphalt-batching processes at the AOCs will take approximately 12 months to complete. Monitoring site conditions will involve collecting and analyzing groundwater samples and inspecting site conditions.

Statement of the Continued Protection of Human Health and the Environment

The PRA developed conservative estimates of risk to potential human and ecological receptors based on assumptions presented in the MMR RAH (HAZWRAP, 1994a). The RAH describes procedures and provides support information for risk assessment activities at MMR. The RAH provides a framework to streamline the risk assessment process and summarizes site-specific approaches to reservation wide risk assessment.

The RAH provides target risk levels for comparison to estimated risks at MMR. The RAH identifies target risk levels consistent with the U.S. Environmental Protection Agency's (USEPA) guidelines: the total incremental carcinogenic risk for an individual should not exceed 1×10^{-4} to 1×10^{-6} and the HI should not exceed 1.0. The Massachusetts Contingency Plan (MCP) sets the target carcinogenic risk level at 1×10^{-5} and the HI level at 1.0. The PRA considers incremental carcinogenic risks exceeding 1×10^{-4} and HIs exceeding 1.0 (for human health and ecological receptors) as significant.

Risk estimates included in the PRA represent conservative worst-case scenarios for exposure to COCs. For AOCs CS-16/CS-17, risk estimates were presented in the final RI prepared by ABB.



The risk-based cleanup goals established in this section are considered to be consistent with the estimated site risks developed based on conservative exposure scenarios.

No unacceptable risks to human receptors were identified at AOCs CS-16/CS-17. The exposures to COCs at AOCs CS-16/CS-17 resulted in unacceptable risk to white-footed mouse, short-tailed shrew, and grasshopper sparrow based on maximum detected concentrations of COCs. These ecological receptors were found to be at risk from Aroclor 1254 and dieldrin. The ecological risk from the inorganic contaminants was deemed to be manageable given the uncertainty in the risk assessment.

Surface soil contaminants will be stabilized in such a manner that contact between human and ecological receptors will be limited such that excess potential risk will not result. This stabilization process will also minimize the potential for surface soil contaminants that exceed the risk-based STCLs to leach into the groundwater. Therefore, this alternative will be protective of human health and the environment.



APPENDIX F.6

Site Name: Chemical Spill-16/Chemical Spill-17 DDOU

Site Description

The DDOU consists of a clearing in a wooded area located southeast of the former MMR sewage treatment plant at AOC CS-16/CS-17 (Figure 6). A sanitary sewer sludge disposal area is located southwest of the DDOU. The ground slope in the area of the DDOU is nearly level with no severe slopes. Hummocks and other surface features were observed in the more densely wooded area southwest of the DDOU in the area formerly used for sludge disposal. A trench feature also was observed at the DDOU that contained black sludgelike material (Advanced Sciences, Inc. [ASI], 1997).

The DDOU was discovered during RI activities at AOCs CS-16/CS-17 in 1994. A total of 11 drums was observed in the area on the ground surface. After discovery of the drums, the National Guard Bureau (NGB) removed the drums from the site, analyzed the contents, and disposed of them accordingly. Based on this discovery, two surface-soil samples were collected and analyzed as part of the AOC CS-16/CS-17 RI. Results of sample analysis indicated that the two surface samples contained pesticides and other analytes. The pesticides, particularly 4,4'-DDT, 4,4'-dichlorodiphenyldichloroethane (DDD), 4,4'-dichlorodiphenyldichloroethylene (DDE), and alpha-benzene hexachloride (BHC), were found at concentrations up to several hundred milligrams per kilogram. Based on these findings, an investigative program was conducted by ASI in 1994. As part of the 1994 investigation, ASI completed four soil borings as monitoring wells, completed 22 Geoprobe borings, and collected 10 surface soil samples. The following subsections discuss results of analyses and screening conducted on soil and groundwater samples.

The ASI report identified two areas of soil contamination that contained pesticides above MMR STCLs; one area measuring approximately 60 by 40 feet (Area 1) encompassing Drum Nos. 1 through 7, and the other approximately 20 by 50 feet (Area 2) inclusive of Drum Nos. 9 through 11. SVOCs and inorganic analytes at concentrations above STCLs were found commingled in the two areas of pesticide contamination. Data from Area 1 indicated 4,4'-DDT concentrations in surface soil (i.e., SS-8) as high as 36,000 mg/kg. In the same location, concentrations of 4,4'-DDE and 4,4'-DDD were reported at 450 and 3,800 mg/kg, respectively. The pesticide alpha-BHC also was found at concentrations above the STCL. The highest concentration, 490J mg/kg, was reported at sample location SS-8. SVOCs were found in excess of STCL in a small portion within Area 1, which encompasses Drum Nos. 4 and 5. In addition, several inorganic analytes, including arsenic, chromium, lead, vanadium, and zinc, were found at concentrations exceeding respective STCLs within this area.

A PRE was not conducted for this study area. Additional information and data on the DDOU is in the Final Technical Memorandum (ASI, 1997).



Discussion of Remedial Objectives

Removal action objectives were developed and established to achieve the overall objective of protecting human health and the environment for the Priority 2 and 3 study areas as described in appendix F.1.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

It is recommended that the selected remedy for CS-16/CS-17 DDOU as described for the Priority 2 and 3 sites be implemented as described in appendix F.1.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the study areas. See appendix F.1 for detail.



APPENDIX F.7

Site Name: FTA-1 Current Fire Training Area (Source)

Site Description

Former FTA No. 1 is located 500 feet north of Kittredge Road near the southern boundary of MMR. The base STP lies between the AOC and the MMR boundary, which is approximately 1,800 feet south of AOC FTA-1 (Figure 6). The AOC consists of a level, cleared area of approximately 3 acres that was used by the MMR fire department for fire-training activities from 1958 to 1985. The AOC was closed in November 1985 because of air emission permitting difficulties.

Six to 16 fire-training exercises were held annually in designated areas of the AOC, during which flammable waste liquids from the flightline area were burned and extinguished (Metcalf and Eddy, Inc., 1983). Fire-training activities consisted of dumping flammable materials onto a concrete pad or into unlined pits, igniting, and extinguishing the fires with water, foam, or dry chemicals. The residual mixture would evaporate or infiltrate into the soils overnight, and the remainder was burned off the next day to eliminate any fire hazard (E.C. Jordan Co., 1988). The materials burned included jet fuel (i.e., JP-4), AVGAS, MOGAS, diesel fuels, waste oils, solvents, paint thinners, transformer oils, and spent hydraulic fluids. Substances used to extinguish fires included carbon dioxide, protein foam, aqueous film-forming foam, a bromine-based dry powder, and liquid chlorobromomethane.

The technical approach developed for the RI program partitioned AOC FTA-1 into two operable units: (1) the FTA-1 source operable unit and (2) the FTA-1 groundwater operable unit. To accomplish the scope of the RI, the field exploration program was designed to be operable unit specific. Results of the FTA-1 source operable unit RI confirmed the presence of fuel- and solvent-related contamination in soils throughout the cleared portion of the AOC and in the sediments and surface water perched in the drainage pit. Residual contamination was highest in shallow soils (i.e., less than 10 feet deep) beneath and adjacent to the concrete pad in the center of the site clearing. In addition, PCBs, pesticides, and low levels of dioxin were detected in surface soils. Lead was consistently detected at levels greater than 10 times background levels for the MMR, and the water in the drainage pit exceeded the state and federal MCLs for lead. Contamination found at AOC FTA-1 is a direct result of the infiltration of unburned wastes during historical fire-training activities.

Several classes of contaminants detected in AOC FTA-1 (i.e., inorganics, SVOCs, pesticides, PCBs, and dioxins) are stable in soil environments and will remain in the soils. In contrast, the VOCs in the soil (i.e., BTEX and chlorinated solvents) will leach to groundwater and continue to contaminate that medium. Results of the FTA-1 groundwater investigation are presented in the interim RI report for the groundwater operable unit.

A PRA was conducted to evaluate potential risks from the most probable exposure scenario at the FTA-1 source operable unit (i.e., children from nearby residential areas playing in the soil and being exposed through dermal contact and incidental ingestion). The estimated carcinogenic risks from such exposure routes are at the low end and within the USEPA target risk range. The



noncarcinogenic risks are less than the USEPA target hazard index (HI) of 1.0 and do not indicate a significant human health risk. The draft results from the FTA-1 source operable unit investigations have been assessed in an EE/CA prepared to address remedial alternatives for AOCs FTA-1, FS-25, and CS-4 at MMR. The EE/CA is the foundation for the planned removal action of an estimated 16,500 cubic yards of soil from AOC FTA-1. Contaminated soil was excavated and treated using a low-temperature thermal treatment process. Treated soil was backfilled into the excavated area and is detailed in *MMR Plume Response Program, Draft Closure Report, FTA-1, October 1997*. A *Draft Remedial Action Summary Report, FTA-1, May 1998* has been submitted and is undergoing regulatory review.

Discussion of Remedial Objectives

Specific AOCs addressed under removal action specifications (ABB-ES, 1992b), herein referred to as the Soil Thermal Treatment Program, have been previously characterized through site and remedial investigation activities by NGB. From these investigations it was determined the AOC source area soils were contributing, or may have potential to contribute, contaminants into environmental media. Because of existing regulation under federal and Commonwealth of Massachusetts guidance, NGB determined that these AOCs should be remediated.

An EE/CA (ABB-ES, 1991a), provided identification of remedial objectives and determination of Removal Action alternatives. A contaminant source Removal Action memorandum and a detailed design package were completed in 1992 (ABB-ES, 1992a and 1992b). The performance-based Removal Action design was based on contaminated soil excavation/removal; low-temperature thermal desorption of contaminants from soils; segregation and disposal of various process-generated media (i.e., dust, condensate); treatment of process air stream discharge to 95 percent efficiency; and verification of soil treatment and excavation closure based on comparison of chemical analysis to predetermined soil treatment criteria.

Thermal treatment devices employed successfully treated approximately 60,000 tons of VOC- and TPH-contaminated soils. As a result of this soil treatment, approximately 1 ton of baghouse dust; 10,000 gallons of condensed fuels and/or oils; 805,994 gallons of condensed industrial wastewater; 7,300 tons of oversized classified debris (i.e., woody waste, rocks); and 179,000 pounds of aqueous- and vapor-phase granular activated carbon were generated, managed, and disposed of at appropriately licensed and/or permitted transportation and disposal facilities. Upon achieving laboratory-verified treatment criteria, through testing at preapproved volume increments, treated soils were returned to excavation areas for backfilling as directed by the specifications.

All laboratory analytical data, process treatment records, quality control, and project records are on file at the MMR IRP offices at the Otis ANG Base. Harding Lawson Associates (HLA) was contracted through HAZWRAP for construction technical support services throughout the contract period. Technical support service reviews and inspections indicate the Removal Action was conducted in compliance with the contract documents and technical specifications. The project was found to be substantially complete in October 1997.



Areas of Noncompliance

Currently there are no areas of noncompliance.

Recommendations

The AOCs and contaminated soils associated with the Soil Thermal Treatment Program have been successfully remediated.

The site is recommended for closure.

Statement of the Continued Protection of Human Health and the Environment

Upon completion of the planned remedial activities at the FTA-1 site detailed in the site closure report (1997), and after reviewing the associated analytical results of the thermal treatment, AFCEE recommends that the site is prepared for closure. The analytical results support the recommendation for closure as the site does not pose a risk to human health and the surrounding environment.



APPENDIX F.8

Site Name: Fuel Spill-1 AVGAS Test Dump Site (Source and Plume Area)

Site Description

This industrialized region includes structures, runways, and taxiways for the support of flight operations. The FS-1 source area [considered the Western Aircraft Turnaround (WAT)] is located within the flightline area (Figure 6). The WAT is constructed of concrete and asphalt and is located in an area once used as a source for borrow material. The area containing the WAT is sparsely vegetated, and the northern and southern boundaries of the borrow area are denoted by steep soil slopes capped by heavily vegetated forest.

Although land use in areas adjacent to MMR is mainly residential, recreational, and agricultural, few residences exist in the area between the FS-1 source area and the suspected discharge point for groundwater (cranberry bog and the Quashnet river). The off-base land adjacent to this portion of MMR is heavily wooded and undeveloped with the exception of one home at the end of Ashumet Road, cranberry bogs, and an abandoned borrow pit. Ashumet and Johns Pond are located in the general vicinity but are not expected to be affected by contamination from AOC FS-1. Agricultural land adjacent to this portion of MMR includes active cranberry bogs located east of Johns Pond and south of the MMR base boundary. The Township of Mashpee has investigated one area south of the FS-1 source area for the potential site of a drinking water well (P-11) (D.L. Maher, 1992).

For the source area, the human health risk assessment concluded that there were no risks posed by exposure to surface soils, however groundwater in the source area had detections of toluene, methylene chloride, arsenic, and lead that pose a potential risk in residential scenarios. Minimal concentrations of regulated compounds were quantified during field investigations. Compound-specific VOCs were not quantified with one exception. Elevated levels of methylene chloride were detected. However, it was assumed that the detection was not site related because there was no site history of its use at FS-1. The only SVOC detected was BEHP in a single soil boring sample. Lead was the only metal detected above background in subsurface soils. No VOCs or pesticides/PCB were detected.

The distribution of EDB in groundwater from the northernmost detection point to the discharge at the cranberry bogs is approximately 6000 feet in length, 600 to 1200 feet in width, and 50 to 100 feet thick. The estimated volume of contaminated groundwater contained in the plume is 911 million gallons, including 2.7 gallons of EDB. The plume is thickest at the leading edge where the contamination begins at the surface to a depth of 180 feet below the ground surface.

Discussion of Remedial Objectives

FS-1 RI Report concluded that action was warranted to address risks from exposure to groundwater and surface water, therefore RAOs have been developed and presented in the Revised Draft Feasibility Study.

A pilot test of a Groundwater extraction system at the toe of the FS- I plume in the Quashnet River area bogs was performed to:



- Implement and evaluate an extraction, treatment, and discharge system to intercept EDB-contaminated Groundwater at the leading, edge of the FS-1 plume;
- Protect human health by reducing the risk from EDB in surface water, groundwater, and cranberry crops, while minimizing impacts to ecological systems;
- Accelerate the restoration of the Quashnet River currently impacted by elevated EDB concentrations

The components of the system include: a deep extraction well (EW-5, screened from '90' to 150' MSL); shallow well points; granulated activated carbon treatment plant for EDB contaminated groundwater; berms, and discharge to surface water and to subsurface. System start-up is scheduled for April 1999.

The final cleanup levels for remediation at AOC FS-1 are as follows:

<u>COC</u>	<u>Cleanup level</u>
arsenic	50 µg/L
EDB	0.02 µg/L
lead	15 µg/L
toluene	1000 µg/L

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Another Five-year review is recommended since it is expected that Groundwater cleanup levels will not be attained within five years.

Statement of the Continued Protection of Human Health and the Environment

With successful implementation of the pilot test system at the leading, edge of the FS-1 plume, groundwater contaminants will be removed from the aquifer. In addition, surface water concentrations of the EDB will be reduced thereby reducing risks from exposure to surface water. The body of the FS-1 plume underlies Town of Mashpee conservation land and does not currently impact any public water supplies. Also, lead and VOCs in the groundwater within the source area, the aircraft turnaround area, does not pose a risk since groundwater in this area is not used.

Operations of the pilot test system will be closely monitored due to the sensitive habitats found in the area of the Quashnet River bogs. An ecological sampling plan has been developed to ensure that the treatment system does not impact a sensitive brook trout habitat.



APPENDIX F.9

Site Name: Fuel Spill-4 Current Product Tank 100/101

Site Description

Study Area FS-4 consists of the area surrounding the former Building 178, a fuel pumphouse, located on the base airfield (Figure 6). During Phase 3 of the SI, Study Area FS-4 was observed to be nearly level, with grass around the pavement and building to the west, north, and south. East of the study area was a large expanse of tarmac. This study area is within the restricted zone of the flightline, and access can be gained only by authorized personnel.

Although the USTs at the study area were discussed in the Task 6 records search, the site did not become a formal study area until one UST failed a leak test. Between 1985 and 1989, the USTs at the study area were tested; test results indicated that CPT-7 was leaking. CPT-7 was one of five USTs, CPT-6 through CPT-10, located at the pumphouse, that were installed in 1956. The USTs were removed in 1994 under the FSU program. CPT-6 through CPT-9 had a 25,000-gallon capacity and were used to store AVGAS. CPT-10 had a 2,000-gallon capacity and was used to store diesel fuel but was reported empty at the time of the records search (E.C. Jordan Co., 1986a).

During Phases 1 and 2 of the SI field program, CPT-7 reportedly was used to store deicer fluid; CPT-6, CPT-8, and CPT-9 continued to store AVGAS. CPT-10 reportedly was empty. Each of the five USTs, including CPT-7, passed leak tests conducted by the ANG in October 1989. According to MMR personnel, CPT-7 was empty and not being used in 1993.

In 1994, the five USTs at Pumphouse 178 were removed along with a 25,000-gallon defueling UST located east of the former pumphouse. The pumphouse was demolished to gain access to the underlying USTs. According to the UST closure reports (Metcalf & Eddy [M&E], 1994), PID headspace readings up to 3,200 ppm were recorded on soil from 22 feet bgs from the excavation of the 25,000-gallon defueling UST. In the excavation for the 2,000-gallon collection UST (i.e., CPT-10), final PID headspace readings as high as 850 ppm were recorded at 10 feet bgs.

Study Area FS-4 geology consists of 4 to 6 feet of fill with a consistency of silty sand, and fine-to-medium sand overlying outwash sand. The outwash sand was typically identified as a well-sorted, medium-to-coarse grading to medium sand with trace gravel. Explorations were terminated in the outwash, approximately 66 to 70 feet bgs, or approximately 40–43 feet above mean sea level (MSL).

To identify potential risks associated with exposures to study-area-related CPCs, a sitewide PRE was conducted for surface and subsurface soils at Study Area FS-4, including both human health and ecological exposure scenarios. The PRE was intended not to quantify study area-specific risks, but rather to indicate whether risks above regulatory guidance levels are possible. A detailed discussion of the PRE methodology is in the RAH (ASG, 1994). The PRE was completed in 1995. Due to the relatively low concentrations of compounds detected during the Supplemental Investigation, the PRE was not updated to include those results.



Results of Tier I of the human health PRE showed no HEC exceedences for surface or subsurface soil. Tier I HECs for BEHP and cadmium were exceeded in Phase I groundwater samples from the study area. Tier II human health HEC exceedences were not identified in groundwater. However, maximum BEHP and cadmium concentrations exceeded their respective MCLs.

Tiers I and II of the ecological PRE showed that maximum surface soil concentrations of several PAHs, as well as dieldrin and arsenic, exceeded the lowest HECs. HIs for the upland sandpiper exceeded 1 for organics but were less than 10 for inorganics. Organic and inorganic HIs for both the meadow vole and the red fox were below 1 and 10, respectively. The organic HI for plants exceeded 1, although chemical-specific hazard quotients (HQs) were all less than 1. The inorganic HI for plants was less than 10.

The draft Priority 2 and 3 Study Areas SI report recommended that no further action be conducted at this study area depending on results of FSU program activities. Based on qualitative data obtained during removal of USTs at this study area, residual fuel contamination exists below the former 2,000-gallon collection tank and the former 25,000-gallon defueling UST. According to the text and tables in the UST closure report (M&E, 1994), PID headspace readings as high as 3,200 ppm were reported for soil collected from 22 feet bgs at the 25,000-gallon defueling UST location. Each soil sample collected from the side walls of the excavation was 150 ppm or less, with the exception of a sample obtained from the southern side of excavation at 8 feet bgs. According to the UST closure report, the final size of the excavation was approximately 40 feet wide by 60 feet long and 22 feet deep.

PID headspace readings as high as 850 ppm were reported for samples collected from the bottom excavation (i.e., 10 feet bgs) for the 2,000-gallon UST. Each side wall sample collected from this excavation had 0 ppm headspace readings (M&E, 1994). According to the UST Closure Report, the final size of the excavation was approximately 10 feet wide by 20 feet long and 10 feet deep. Qualitative PID headspace results obtained during the UST removals are the basis for this study area being included in the EE/CA.

Discussion of Remedial Objectives

At Study Area FS-4, residual fuel contamination from past UST releases may be present in subsurface soil, and may have the potential to leach to groundwater. AFCEE requested a removal action at this study area based on elevated PID readings during the FSU program.

- Removal action objectives were developed based on these considerations and were established to achieve the overall objective of protecting human health and the environment. Details and schedule of remedial action for this site are contained in appendix F.1.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations



A low-flow SVE system will be constructed at Study Area FS-4 to remove contaminants from deep subsurface soil, if necessary. The details of the recommendations for Priority 2 and 3 sites are contained in Appendix F.1.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the study areas. See appendix F.1 statement of the continued protection of human health and the environment for details.



APPENDIX F.10

Site Name: Fuel Spill-7 Current Product Tank 115

Site Description

Study Area FS-7 is located adjacent to the former Building 1820 on the northwestern rotary (Figure 6). The area north, east, and south of this building was observed to be grassed with pavement on the western side of the building. The study area was nearly level with no significant topographic relief. Buildings 1640 and 1670 were formerly located south of Building 1820, but had been removed prior to 1990.

Study Area FS-7 was evaluated as part of the Task 6 records search (E.C. Jordan Co., 1986a). According to the records search, CPT-115, a 500-gallon UST installed in 1970 and used to store No. 2 fuel oil, may have leaked up to 11,000 gallons of fuel. According to records, CPT-115 was removed in June 1985. It is unclear whether soil around the tank was removed or placed back in the excavation after tank removal. As part of the records search, the study area was ranked using the HARM system, receiving an overall score of 56.1, and the records search report recommended that a limited Phase II SI be conducted.

In 1996, Building 1820 at the study area was razed and the asphalt driveway that surrounded the building was removed.

Results of Tier I of the human health PRE for future residential use showed HEC exceedences for selected SVOCs, arsenic, and beryllium in surface soil, and benzene, arsenic, iron, and manganese in groundwater. Tier II human health HEC exceedences were not identified in soil or groundwater samples.

Tiers I and II of the ecological PRE showed that maximum concentrations of several organic and inorganic chemicals exceeded the lowest HECs. HIs for the upland sandpiper exceeded 1 for organics and equaled 10 for inorganics. For the white-footed mouse, there were no HEC exceedences of organic chemicals, and the HI for inorganics was less than 10. There were no HEC exceedences for the red fox, and both organic and inorganic HIs were less than 1. The organic HI for plants exceeded 1, although chemical-specific HQs for organics were less than 1. The inorganic HI for plants was less than 10.

The conclusion made based on data from Phases 1 through 3 of the SI were as follows:

- Maximum concentrations of arsenic, antimony, beryllium, cobalt, and manganese observed in surface soil samples at the study area were lower than the maximum concentrations of these analytes reported at MMR. It is likely that a majority of the analyte concentrations are naturally occurring with additions from nonpoint sources. Therefore, risks posed to ecological and human receptors are likely consistent with background concentrations and do not warrant further consideration.
- PAH concentrations are likely the result of nonpoint sources in this part of MMR. Sources include exhaust and minor releases (i.e., oil/fuel leaks in vehicles) from relatively heavy



motor vehicle traffic and exhaust from airplanes. Therefore, actions based on detected concentrations of these compounds do not warrant any further consideration as part of this study area.

- Results of the ecological PRE likely overestimate risk because use of the site area by the ecological receptors evaluated, to the extent assumed in exposure assessment, is unlikely. In addition, residential development of the area is unlikely in the near future. Therefore, adverse risk impacts are not expected to either ecological or human receptors.

Based on these conclusions, the following actions were recommended for Study Area FS-7:

- No further action is warranted for existing soil concentrations of inorganics because they are consistent with concentrations observed at MMR.
- Further sample collection is necessary to support the interpretation that PAHs were caused by nonpoint sources.
- Collection of subsurface soil samples from below the former UST is needed to evaluate the condition of soil if data cannot be obtained from the ANG.

In response to the last recommendation, a supplemental SI (SSI) was initiated and completed by Aneptek. The following section describes results and conclusions.

A supplemental phase of SI was conducted by Aneptek Corporation in 1995, consisting of the completion of one test pit, collection of six surface soil samples, and the completion of two soil borings (Aneptek Corporation, 1996). Each soil boring was completed as a monitoring well. A round of groundwater samples also was collected for off-site analysis. The data collected during the SSI were utilized to complete a second PRE for the study area.

Data collected during the SSI showed the presence of PAHs in surface soil above HECs at SS-6 and SS-4. Groundwater contamination documented during the initial SI and SSI was attributed to a fuel spill located upgradient of Study Area FS-7 (i.e., FS-13). Based on the SSI PRE, which showed exceedences of HECs by several PAHs, Aneptek Corporation recommended that a soil remediation be conducted to remove contaminants detected at SS-6.

Discussion of Remedial Objectives

Removal action objectives were developed for Priority 2 and 3 sites and are detailed in appendix F.1. Human and ecological receptors may be exposed to unacceptable risk from exposure to PAHs at Study Area FS-7.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Implement the selected remedy for Priority 2 and 3 sites as detailed in appendix F.1.



Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the study areas. See the statement of the continued protection of human health and the environment in appendix F.1 for details.



APPENDIX F.11

Site Name: Fuel Spill-9 Current Product Tank 108

Site Description

AOC FS-9 is located in the south central portion of MMR (Figure 6). The site has been and is being used for military vehicle maintenance. The site encompasses an area of approximately 7 acres and extends south a distance of approximately 720 feet from Building 1369 at the intersection of Beaman Road and West Truck Road to Building 1365. The paved portion of the site extends west a distance of approximately 120 feet, where it is bounded by undeveloped land. The undeveloped portion of the site extends to the west an additional 370 feet and includes a small vernal pool and drainage ditch, which originates at the western edge of the paved area.

The developed portion of AOC FS-9 was a motor pool that remained in service from World War II until 1986. At the time of the RI field investigations, the site included five buildings (Buildings 1365, 1366, 1367, 1368, and 1369); three 5,000-gallon steel USTs designated CPT-106, CPT-107, and CPT-108; a fuel island used for dispensing gasoline and diesel fuel; a catch basin located in the fueling area; and two waste disposal wells located adjacent to Buildings 1368 and 1369. Presently, the site includes the buildings and the closed leaching well. The USTs, dispensing pumps, and catch basin were removed during the FSU program. The waste disposal leaching well was cleaned and grouted in place during the DSRP.

The undeveloped portion of AOC FS-9 is primarily a grassy or pine covered area. Storm sewer headwalls discharge west of the paved portion of the site into a drainage ditch. The drainage ditch leads to a depression west of the site; the depression contains water for substantial parts of the year. This depression has been classified as a vernal pool. A portion of the undeveloped area immediately adjacent to the paved area but not within the drainage ditch or depression is referred to in the RI as the "waste disposal area." The nomenclature is retained in this study for clarity and continuity.

Some source control actions have already been conducted at FS-9. Three USTs and related fuel-dispensing equipment were removed as part of the MMR FSU program in August 1994. Under the DSRP, a catch basin and leaching well were removed and another leaching well was abandoned in place after decontamination of the structures and removal of all wastes. The DSRP is a systematic basewide investigation and cleanup effort to address drainage sumps that were used historically at MMR, including those at FS-9. Removal activities conducted under the DSRP are described more completely in *Drainage Structure Removal Program Remedial Action Workplan* (Jacobs Engineering Group, 1995). The DSRP activities will be summarized in *Drainage Structure Removal Program Remedial Action Summary Report* (ABB-ES, 1998), which is under review by USEPA and MADEP.

AFCEE's activities to date at FS-9 carried out under the IRP include performing an SI and RI to characterize the nature and distribution of contamination. Risk assessments were performed as part of the RI to identify potential risks from exposure to contaminants. The risk assessment evaluated the present and future risks to human health and the environment posed by existing conditions, assuming no remedial action is taken. Cancer and noncancer risks were evaluated.



Additional activities include preparing a feasibility study (October 1998) to develop and evaluate remedial action alternatives to reduce site risks and preparing this proposed plan.

The proposed plan (October 1998) summarizes the RI/FS and presents cleanup actions proposed for soils at three specific areas within FS-9. The proposed plan, which is based on the feasibility study, describes various cleanup alternatives and the AFCEE preferred alternative. After careful consideration of several alternatives, AFCEE believes the proposed actions composing the AFCEE preferred remedial alternative will protect human health and the environment and will comply with environmental laws and regulations. The proposed plan is currently undergoing regulatory review.

Discussion of Remedial Objectives

The potential risk to terrestrial ecological and human health receptors from exposure to soil was identified at FS-9. The MMR-specific risk-based STCLs and the MADEP MCP S-1/GW-1 standards define the soil concentrations protective of ecological and human health receptors. For those remediation options requiring soil removal or treatment based on risk assessment, the human health STCLs, background concentrations, and the MADEP MCP S-1/GW-1 standards will be used as cleanup goals in the FS.

For AOC FS-9, response objectives were formulated for the former UST location (CPT-107/CPT-108), the TPH hot spot (TP-11), and the fence-line hot spot (SS-1) based on the environmental problems defined in the final RI, PRA, risk analyses associated with extractable petroleum hydrocarbon/volatile petroleum hydrocarbon (EPH/VPH) samples performed in accordance with MADEP guidance, and ARARs analysis. These response objectives are used to develop RAOs and appropriate remedial alternatives. Results of the field studies are presented in the RI report (CDM Federal, 1997).

The following response objectives were identified for AOC FS-9:

- Reduce exposure of human health receptors to the identified COCs (TPH, C₅–C₈ aliphatics, and lead) in the former UST location, TPH hot spot, and fence-line soil hot spot.
- Reduce exposure of terrestrial ecological receptors to identified COCs (chromium, vanadium, and zinc) in the former UST location and fence-line soil hot spot.

Guidance for the use of the MMR STCLs and MADEP MCP S-1/GW-1 standards require the following:

- The maximum detected concentration of contaminations identified as posing unacceptable risk in the soils was compared to the chemical-specific STCL for outside the flightline (human health considered soils ranging from ~10 feet and terrestrial receptors 0-2 feet). AOCs where these contaminants were detected in maximum concentration exceeding the STCL were identified as requiring response action to achieve the response objective.
- Locations for which MADEP type EPH/VPH TPH risk evaluation concentrations exceed MADEP thresholds protection of human health.



- Locations for which EPH/VPH TPH data or comparable data are unavailable require either confirmation sampling or remediation if TPH was quantified using noncompound/nonclass-specific methods at levels exceeding the STCLs. During confirmatory sampling as part of the Fuel Storage Systems Upgrade, detections of TPH exceeding the stated levels was found in the former UST location. Therefore, remedial actions are warranted.

The COCs identified by this process (TPH, CS-8, chromium, lead, vanadium, and zinc) and the associated MMR TCLs and MADEP MCP standards are presented in Tables 3-13 and 3-14. The final cleanup levels for remediation AOC FS-9 are as follows:

<u>COC</u>	<u>Cleanup level</u>
Chromium	6.8 mg/kg
Lead	300 mg/kg
Vanadium	15.2 mg/kg
Zinc	16.0 mg/kg
TPH	500 mg/kg with a goal of 200 mg/kg
C ₅ -C ₈	100 mg/kg

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The cleanup goals established for soil at FS-9 are STCLs and MADEP soil cleanup standards, developed under the MCP. The STCLs are MMR-specific, risk-based and leaching-based concentrations protective of human health and the environment. STCLs were developed during the MMR DSRP. The MADEP standards were applied to address concerns regarding the potential presence of “nontarget hydrocarbons” including TPH and C₅-C₈ aliphatic hydrocarbons. The RI for FS-9 identified contaminants that pose unacceptable risk to human and ecological receptors from potential exposure to surface and subsurface soils. These contaminants were compared to risk-based STCLs and MADEP standards to determine the extent to which an area must be remediated.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Implemented the selected remedy. AFCEE’s preferred alternative for FS-9 is Alternative 4, excavation and on-site asphalt batching with contingency low-flow SVE. AFCEE believes the preferred alternative provides the best combination of solutions for conditions and contaminants at each of the three source areas at the site. The excavation and on-site asphalt batching address the cleanup of soils at the three areas, and the in situ SVE addresses the potential cleanup of deeper soils if they are encountered at the former UST location. Monitoring would be conducted as required under CERCLA for at least five years to ensure the effectiveness of the removal/treatment activity. In addition, a five-year review will be performed.



Statement of the Continued Protection of Human Health and the Environment

The selected alternative will reduce the toxicity and mobility of soil contaminants through treatment. The reduction in toxicity and mobility will be attained by stabilizing the contaminants in an asphalt matrix or removal and destruction of the contaminants with the SVE system. The stabilized mass will have the structural and chemical binding properties to reduce the toxicity and mobility of the contaminants. This alternative will increase the volume of contaminated materials because of the introduction of additives (bulking agents, aggregate, and asphalt). The total volume of contaminated material may increase by 20 to 40 percent; however, the asphalt product from this process can be used as subgrade material for other paving projects performed at MMR. This alternative satisfies CERCLA's statutory preference for treatment as a principal component of a remedial action.

Soil contaminants will be stabilized, extracted, or destroyed so that contact with receptors will be limited such that excess potential risk will not occur. This stabilization process will also minimize the potential for soil contaminants to leach into the groundwater. Therefore, this alternative will be protective of human health and the environment.



APPENDIX F.12

Site Name: Fuel Spill-18 Fuel Transfer Point**Site Description**

Study Area FS-18, a World War II motor pool and fuel transfer site, is located off North Gaffney Street, on the northwestern side of MMR (Figure 6). The study area slopes gently to the west of North Gaffney Street, with a small depression observed on the western side of the study area.

East of South Gaffney Street and south of North Gaffney Street, the topography slopes downward toward a drainage course. The drainage course receives storm-water discharge from the paved portion of Study Area FS-18. Flow from the outlet has created an intermittent drainage course that has a small bottom channel measuring 1–2 feet across.

According to the MMR records search, four 5,000-gallon USTs were installed at the study area in 1941 (E.C. Jordan Co., 1986a). Two tanks, Current Product Tank (CPT)-102 and CPT-103 were associated with a fuel-pump island adjacent to Building 3591 and contained diesel fuel. Similarly, there were two USTs, CPT-100 and CPT-101, associated with a fuel-pump island at Building 3594, and were reported to contain motor vehicle gasoline. According to available leak test records from the ARNG, CPT-100 and CPT-101 failed a hydrostatic leak test in May 1985. Each UST was reportedly emptied in June 1985 and later removed.

During the SI, three leaching wells were identified; one was sampled for chemical analysis (Leaching Well No. 1). The two other leaching wells (Leaching Well Nos. 4 and 5) were found to be destroyed and/or backfilled and could not be sampled. During the DSRP, two additional leaching wells located north of Building 3594 and former Building 3591 were identified (Leaching Well Nos. 4 and 5). Four vehicle maintenance pits were also identified. These nine drainage structures and approximately 430 cy of surrounding soil were removed as part of the DSRP in 1996 and treated in an on-site asphalt-batching facility.

Three motor vehicle maintenance buildings, Buildings 3592, 3593, and 3595, were also part of the Study Area FS-18 motor pool. Demolition of the motor pool buildings occurred in late 1990. In 1990, the study area was paved and partially fenced north of the former motor-pool buildings. The fence has been since completed, and ARNG vehicles are stored in this area.

An area of demolition debris disposal on the western side of the study area also was evaluated as part of the SI. It appears that construction-debris fill was used to partially fill a topographical depression west of Building 3591. Pieces of rebar, concrete, brick, and metal strapping were observed in the fill.

The diesel-fuel system located at Building 3591 was active during the SI field program. There are no failing leak test records for CPT-102 or CPT-103. According to MMR personnel, CPT-102 and CPT-103 were removed in August 1994.



Based on the past uses of Study Area FS-18, fuels and lesser amounts of solvents may have been spilled and released during vehicle maintenance activities. A summary of the nature and distribution of contaminants detected at Study Area FS-18 follows and focuses on site soil.

Based on results of chemical analysis, sediment in the depression west of the study area has been affected by the use of leaded fuel-related products. Concentrations of PAHs and petroleum hydrocarbons in this depression and in the drainage course on the eastern side of South Gaffney Road indicate releases and contaminant transport from the study area. The lack of detections of high concentrations of PAHs in study area soil and sediment samples indicates that the PAHs detected in these locations may be the result of nonpoint sources (e.g., automobile exhaust transported by storm-water runoff) and the accumulation of persistent fuel-related compounds (i.e., PAHs and other nonvolatile petroleum hydrocarbons) from past and current industrial use of Study Area FS-18 and the heavily traveled roads (i.e., Connery Avenue) bordering the study area.

Groundwater quality appears not to have been affected by study area activities, other than the detection of some inorganic concentrations (i.e., sodium and cyanide) above MMR background levels. The detected inorganic analytes occurring above MMR background may be attributable, in whole or in part, to road-salt use.

PRE results indicated potential risks to human health due to concentrations of benzo(a)pyrene (BaP), arsenic, beryllium, and iron. Each inorganic detected above human health Tier I HECs was at concentrations below those documented to occur in this soil type. Therefore, the inorganic concentrations alone are not necessarily indicative of site contamination. Based on the detected concentrations of dieldrin and BaP, the presence of these compounds is likely due to normal historical use and nonpoint sources (e.g., exhaust), respectively.

The PRE also indicates potential risk to ecological receptors from several inorganics. In addition, a majority of the risk caused by the presence of these inorganics is from background concentrations documented in this soil type (Kabata-Pendias and Pendias, 1984).

The drainage course east of South Gaffney Street has been affected by petroleum compounds. Although human health and ecological HECs are not available, qualitative evaluation of petroleum-hydrocarbon concentrations indicates a potential effect on human health and ecological receptors. A removal action was recommended for this study area in the Priority 2 and 3 Study Areas SI report (ABB-ES, 1993).

Discussion of Remedial Objectives

Petroleum compounds have affected the drainage course at Study Area FS-18.

Removal action objectives were developed for Priority 2 and 3 sites and are contained in appendix F.1.

Areas of Noncompliance

There are no areas of noncompliance.



Recommendations

Implement the selected remedy for Priority 2 and 3 sites as described in appendix F.1.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the study areas. See appendix F.1 for details.



APPENDIX F.13

Site Name: United States Coast Guard Chemical Spill-4 Hanger 128 Area/United States Coast Guard Fuel Spill-1 Hanger 128 Fuel Spill

Site Description

Study Area CS-4 (USCG)/FS-1 (USCG) is located on Riley Street in the ANG section of MMR and includes the area around Hanger 128 (Figure 6). During the SI, the study area was observed to be nearly level with a gentle slope from north to south. Most of the study area was paved, with areas of grass to the east and west of the aircraft door on the northern side of the hangar. No stains were observed in this area during Phase 3 of the field investigation. Hanger 128 is inside the security gate at MMR, and the northern side of the hangar is in the flightline restricted area. A trench drain, approximately 170 feet long, is present on the northern side of the hangar.

Hanger 128 was first discussed in the Task 6 records search, in which it was identified as a potential source of contaminants contributing to AOC SD-4. Additional evaluation of Study Area CS-4 (USCG)/FS-1 (USCG) was conducted during the Task 7 records search (E.C. Jordan Co., 1986b). Disposal of solvents and petroleum-based oils and lubricants (POLs) onto the hangar floor and infiltration through floor joints was cited as a source of potential contaminant release. In addition, two fuel spills were documented on the northern side of the hangar.

From 1955 until 1970, Hanger 128 was used to maintain EC-121 (i.e., Super-Constellation) aircraft owned by the USAF. During this time, unknown quantities of solvents, including toluene and TCE, were flushed into the storm-drain system. Expansion and contraction of fuel-filled wing tanks in the hangar resulted in numerous spills of AVGAS on the hangar deck. This AVGAS was reportedly washed into the storm drainage system (E.C. Jordan Co., 1986b).

From 1976 to 1988, Hanger 128 was used by the USCG to maintain fixed-wing aircraft. Wastes generated at the hangar during this period included waste oils and solvents. These chemicals reportedly were spilled periodically inside and outside the hangar (E.C. Jordan Co., 1986b). Waste oils and solvents were stored in a bowser (i.e., a portable collection tank) outside the hangar. Approximately 25 percent of the wastes stored in the bowser may have spilled onto the ground (E.C. Jordan Co., 1986b).

In 1978, two major spills occurred at the hangar. An AVGAS spill of approximately 1,000 gallons occurred on the tarmac on the northern side of the hangar and was reportedly washed into the storm-drain system. A second AVGAS spill, between 200 and 300 gallons occurring on the southern side of the hangar, was washed off the pavement onto surrounding soil.

As part of the Task 7 records search, Study Area CS-4 (USCG)/FS-1 (USCG) was ranked using the HARM and received an overall score of 54.0. A limited Phase II SI was recommended (E.C. Jordan Co., 1986b).

During Phase 1 of the DSRP, an acid pit was identified on the western side of the hangar. The pit was reportedly sealed and investigated in 1995 during the Priority 2 and 3 Supplemental Investigation.



A summary of the nature and distribution of contaminants detected during the SI and supplemental sampling investigation is presented in this subsection and focuses on soils. CPCs based on analytical data for surface and subsurface soil are listed in Tables 1-6 and 1-7, respectively. Additional discussions of Study Areas CS-4 (USCG)/FS-1 (USCG) are in the Priority 2 and 3 Study Areas SI report and the Supplemental Sampling report (ABB-ES, 1993 and 1995).

The primary contaminant source at the study area appears to be AVGAS, solvents, and POL from spills in and around Hangar 128.

A PRE completed as part of the Draft Priority 2 and 3 Study Areas SI Report was updated to reflect the new maximum concentrations and compounds detected at this study area during the 1995 investigation. Based on results of the updated PRE, a soil removal to mitigate potential risks associated with exposure of humans and ecological receptors to PAHs and inorganics in soil north of Hangar 128 was deemed appropriate by the AFCEE. This study areas was added to the scope of this EE/CA to address the removal of soil on the eastern side of the taxiway leading from the Hangar 128.

Discussion of Remedial Objectives

- At Study Area CS-4 (USCG)/FS-1 (USCG), PAHs and inorganic compounds in soil may pose a risk to ecological and human receptors. Remedial objectives for Priority 2 and 3 sites are detailed in appendix F.1.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

It is recommended that the selected remedy for Priority 2 and 3 sites be implemented as proposed. See appendix F.1 for details.

Statement of the Continued Protection of Human Health and the Environment

The selected alternative will meet removal action objectives and provide protection of human health and the environment at the Priority 2 and 3 areas. See appendix F.1 for details.



Appendix G Source Areas to be Determined (Under Investigation)

List of Sites

G.1	Chemical Spill-4 West Truck Road Motor Pool	G-1
G.2	Chemical Spill-13 Former Contractor Yard	G-3
G.3	Chemical Spill-18 Propellant Burning Area	G-5
G.4	Chemical Spill-19 Impact Range Chemical Dump Site	G-7
G.5	Fuel Spill-2 Railroad Fuel Station	G-9
G.6	Fuel Spill-13 Underground Fuel Line Containment (Source Area)	G-11
G.7	Landfill-4 Johns Pond Dump-Off Base	G-13
G.8	North West Operable Unit (NWOU)	G-14
G.9	South East Regional Groundwater Operable Unit	G-17



APPENDIX G.1

Site Name: Chemical Spill-4 West Truck Road Motor Pool

Site Description

CS-4 West Truck Road Motor Pool is divided into a northern and southern portion. The northern area is the area in the northeastern section of West Truck Road and Gaffney Road (Figure 7). The southern source area is the southwestern section of West Truck Road and Gaffney Road, which was the former motor pool and Defense Property Disposal Office (DPDO) yard. The nature and extent of contamination in this northernmost area was investigated in November 1996 (AFCEE, 1997). Contaminated groundwater attributable from releases at CS-4 are being addressed as part of remedial process for Southwest Operable Unit.

The northern study area investigated during the supplemental SI is located at the northern end of AOC CS-4 SOU, at the northeast intersection of West Truck Road and Gaffney Road. The study area includes a former gasoline station, a former bus terminal, a suspected waste disposal pit, piles of sand and debris, a wetland, and two areas that receive storm-water runoff. During previous investigations conducted at AOC CS-4 SOU, the nature and extent of contamination in this northernmost area was investigated in November 1996 (AFCEE 1997).

The southern study area was investigated in November 1996 (AFCEE 1997). Field observations and analytical results obtained for soils and sediments sampled at the study area show that contamination is generally limited to petroleum-related and chlorinated solvent releases found in surface and shallow subsurface soils in the vicinity of the former USTs/soil piles at the gas station/DPDO yard, at the waste disposal pit, and in the sediments at the northern drainage swale. TPH levels exceeding the proposed MMR STCL of 1,200 mg/kg were found in the surface and subsurface soils at the former gas station and waste disposal pit and in the sediments of the northern drainage swale. Low levels of other petroleum-related constituents in these areas may also be related to past site activities. Low levels of chlorinated solvents found in one surface soil and several test pit samples may be related to past releases during the storage of solvent wastes in the former USTs. Soils in the northern portion of the CS-4 SOU may be the source of the low level of chlorinated solvents identified in the southern portion of the CS-4 source operable unit during the Task 2-5B RI. No significant impacts to surface or subsurface soils at the eastern drainage swale or former bus terminal were noted.

A soil operating unit Feasibility Study and a soil removal action EE/CA report were prepared in May 1993. Thermal treatment of contaminated soil was completed in 1996, as was the removal of a total of 24 drainage structures. Remedial action summary reports on the thermal treatment and DSRP activities were submitted in 1998. Additional soil, groundwater, and sediment sampling conducted in 1997 identified no significant ecological risk at the site. The source area was closed via an action memorandum; additional study has been requested by EPA at an area where a subsurface silt/clay lense may be retaining contaminants migrating through the vadose zone. This data gap study is not yet programmed.

The results of the Tier I risk evaluation indicate that under a worst-case future scenario, maximum concentrations of several chemicals in surface soils (PAHs and dieldrin), subsurface



soil (arsenic), groundwater (benzene, dieldrin, and total inorganics), and surface water [bis(2-ethylhexyl)phthalate (BEHP) and inorganics] exceeded Tier I risk HECs. In the Tier II evaluation for current exposure, only the concentration of manganese in surface water exceeded the Tier II concentrations. According to the RAH, these results indicate that an immediate response and completion of an RI/Feasibility Study would be required. However, the chemicals that exceeded the risk HECs may not be totally attributed to site-related activities.

The ecological PRE concluded that there are potential risks to ecological receptors (i.e., shrew, upland sandpiper, white-footed mouse, cardinal, harrier, muskrat, mallard, American black duck) from site-related contaminants in both swales and the wetland. However, given the physical characteristics of the site and adjacent areas, quality habitat does not exist, and as a result, a significant number of individuals would not be adversely affected by site-related contaminants.

In the southwestern section to CS-4. Approximately 3,000 cubic yards of contaminated soils was excavated and thermally treated by low-temperature thermal desorption in 1996. In the northeastern section, USTs, building structures, and soil/debris piles were also removed.

Discussion of Remedial Objectives

Several removal actions have been conducted at the source since the investigation in 1996. USTs, soil pile, and building structures have been removed. Based on resolution of the SSI Report, limited investigations are needed in a perched water table zone and in the drainage swale sediments in the northern end of the CS-4 source area (EPA, 1999). If this limited investigation identifies contamination warranting action, remedial objectives will be developed.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

As agreed by AFCEE and EPA, a limited investigation in a perched water table zone and a drainage swale will be conducted to determine if further action in site soils or sediment. Further, it is recommended that another five-year review be conducted for CS-4 source area.

Statement of the Continued Protection of Human Health and the Environment

Several removal actions at CS-4 have reduced potential risks with exposure to the contaminated soil. Upon completion of the limited investigation, and if needed, action, a definitive statement of protection of human health and environment can be made.



APPENDIX G.2

Site Name: Chemical Spill-13 Former Contractor Yard

Site Description

CS-13, a former contractors yard and a reported chemical disposal site, is located on private property on the northeastern side of Massachusetts Military Reservation (MMR) (Figure 7). Because the site is close to and generally upgradient from MMR's only currently operating water supply well (Well J) and because low concentrations of volatile inorganic compounds (VOCs) were detected in the well, it has been incorporated into this study. The location of the contractors storage yard is not on MMR property. It was used by base contractors prior to 1959.

Drums containing hardened paint, waste oil, and an unknown oily substance were stored at the site from approximately 1954 to 1984. In 1984, approximately 110 drums were removed from the site by DEQE. Wastes in the drums were never completely characterized, and their origin is unknown. At the time of removal, many drums were found to have bullet holes; reportedly, the majority of the contents had leaked to the ground prior to removal. The site itself is situated in an old gravel or "borrow" pit. As such, there is potential for organic contaminants to have infiltrated into the ground from the drums.

The following studies have been performed on this site to date:

- a. Phase I Records Search (Army National Guard, Air National Guard, United States Air Force, Veterans Administration), Vol. I. Text and Vol. II. Appendices, December 11, 1986.
- b. Phase II/IVA, Task 2-3, Remedial Investigation/Feasibility Work Plan, E.C. Jordan Company, Inc., June 1987 for 21 priority sites.
- c. Site Inspection Report, IRP Task 2-3A, Massachusetts Military Reservation, Vol. I. Text and Vol. II. Appendices, March 1989.
- d. Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns, Camp Edwards, Massachusetts, 25-29 June and 14-15 July 1987, USAEHA.

Discussion of Remedial Objectives

Screening indicates the presence of trace amounts of VOCs in saturated soils downgradient of the contractors storage yard at CS-13. However, laboratory analyses did not detect the presence of any VOCs not attributed to laboratory contamination.

Further field activities are required to define groundwater flow conditions and contamination levels. The accurate responsible party should be identified.

Areas of Noncompliance

There are no areas of noncompliance.



Recommendations

An archive search of the property history is currently being conducted.

Statement of the Continued Protection of Human Health and the Environment

When proper site characterization is achieved a Statement of Continued Protection of Human Health and the Environment can be made.



APPENDIX G.3

Site Name: Chemical Spill-18 Propellant Burning Area**Site Description**

The CS-18 Propellant Burn Areas consists of the 15 or so artillery firing points where past training practices included the routine burning of unused propellant (Figure 7). A single firing point, GP-9, was chosen as representative of the conditions typical to propellant burning at all the firing points. The GP-9 site was selected in part, because it had been previously investigated by USAEHA in 1987. Site GP-9 had the greatest amount of total propellant burning, 1,140 pounds, during the 15-month period prior to that study. Generally, GP-9 was one of the most used sites throughout the history of MMR because it was one of the closest firing points to the cantonment area.

The Army National Guard (ARNG) operates a live-fire range within the confines of Camp Edwards (the ARNG portion of MMR). Bags of common propellant for 155-mm howitzer and 4.2-inch and 81-mm mortars cannot be returned to the issue. Unused propellant is burned at the 15 artillery firing points from which these weapons are fired. Unknown quantities have been burned at MMR since the 1940s. Trace concentrations of lead, used in the propellant bag strings, would remain as residual after burning. Depending on the rate and completeness of burning, traces of propellant (single double-base solid propellants) and 2,4-dinitrotoluene (DNT, used in propellant formulations to control burn rate) could be dispersed into the surface soil. A U.S. Army Environmental Hygiene Agency (USAEHA) 1987 study of the Camp Edwards propellant burning operations concluded that some degree of soil contamination exists at the burn areas (primarily limited to the first two inches of soil) and that the potential for groundwater contamination is possible at howitzer firing positions. Appropriate recommendations were made by the USAEHA. These recommendations included the use of metal burn pans to preclude any chance of contamination in future operations.

The following references summarize previous site studies:

- a. Phase I Records Search (Army National Guard, Air National Guard, United States Air Force, Veterans Administration), Vol. I. Text and Vol. II. Appendices, December 11, 1986.
- b. Site Inspection Report, IRP Task 2-3A, Massachusetts Military Reservation, Vol. I. Text and Vol. II. Appendices, March 1989.
- c. Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns Camp Edwards, Massachusetts, 25–29 June and 14–15 July 1987, USAEHA.
- d. Draft Site Inspection, Geohydrologic Study No. 38-26-0165-87, Propellant Burning at Firing Points (CS-18), MMR, October 1994, USCHPPM.

The following findings are a result of the site investigation (SI):



Soils samples contained varying amounts of 2,4-DNT, 2,6-DNT, n-nitrosodiphenylamine, and di-n-butylphthalate was found in a number of samples. Most of this contamination appears to be randomly scattered throughout the upper 1 foot of soil.

Soils samples for metals showed levels of arsenic, chromium, and lead scattered throughout the site. The levels of metals detected at the site have probably been influenced by site activities.

Groundwater was encountered at depths ranging about 81–84 feet or elevations of about 67–68 feet above mean sea level (msl). On the basis of surveyed elevations and measured water levels, groundwater flows in a westwardly direction. The groundwater sample results do not indicate any significant contamination.

There is no imminent threat to human health at this site. Any current or future risk due to on-site contamination is highly unlikely.

Contamination at this site does not currently pose ecological risk, nor is it expected to in the future. However, if the land use changes in the future, a potential exists for adverse effects to occur for sensitive plants, some small mammals and some birds. This prediction contains a high degree of uncertainty; nonetheless, these potential risks can be considered acceptable (i.e., *de minimis*).

Discussion of Remedial Objectives

The remedial objective for this site is to investigate the surface and subsurface to determine the presence or absence of hazardous materials.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

On July 15, 1997, the U.S. Environmental Protection Agency (EPA) wrote a letter to the Air Force Center for Environmental Excellence (AFCEE) requesting CS-18/CS-19 activities be tolled and that the investigation proceed under the Impact Area Groundwater Study being conducted by the National Guard Bureau (NGB).

Statement of the Continued Protection of Human Health and the Environment

The groundwater sample results do not indicate any significant contamination.

There is no imminent threat to human health at this site. Any current or future risk due to on-site contamination is highly unlikely.

Contamination at this site does not currently pose ecological risk, nor is it expected to in the future. However, if the land use changes in the future, a potential exists for adverse effects to occur for sensitive plants, some small mammals, and some birds. This prediction contains a high degree of uncertainty; nonetheless, these potential risks can be considered acceptable (i.e., *de minimis*).



APPENDIX G.4

Site Name: Chemical Spill-19 Impact Range Chemical Dump Site

Site Description

Study area CS-19 consists of a small, unvegetated area situated within the west central portion of the impact area (Figure 7). The site is approximately 1/3 acre in size and is located about 2,000 feet northeast of Succonsett Pond, and 600 feet due east of Pocasset Sandwich Road. The ground surface at the site is pitted and mounded. The configuration of depressions and stockpiles has been interpreted by EPA to be the locations of burn pits and waste piles from ordnance disposal practices. At least some of the pitting that was observed during the planning of this investigation was from test pits used in the previous site assessment. Portions of the site are littered with spent rocket motors and other metal debris. Because the site is located within the impact area for an active firing range, the potential for unexploded ordnance (UXO) exists on the site.

There are no known records of disposal or site history for study area CS-19. A discussion of activities that may have occurred is presented in the site assessment. That study concluded that the site was used for ordnance disposal. The remains of three former burn pits were also identified. The site had been alleged to have been used to dispose of liquids such as red fuming nitric acid, Aerozine-50, and jet fuel-4 (JP-4). Those alleged disposal activities may have been most prevalent during the late 1960s. Substantive evidence to support the possibility of alleged liquid dumping was not found in the site assessment.

The CS-19 study area was historically used as an ordnance disposal site. The area has been the focus of a 1991–1992 preliminary assessment (PA) (ABB Environmental Services, Inc., 1992), a 1992 site assessment (Air National Guard [ANG], 1992a) and a 1994 limited-focus groundwater contamination SI (U.S. Army Center for Health Promotion and Preventive Medicine [USCHPPM], 1994a). The SI showed that nitroaromatic explosive residues had migrated to the water table in the immediate vicinity of the site. The CS-19 Groundwater Supplemental Site Investigation Work Plan (AFCEE, 1997a) was prepared to direct the investigation to determine whether the groundwater contamination had moved beyond the immediate vicinity of the site and whether there were other sources of nitroaromatic explosive residues in the vicinity. *MMR Draft CS-19 Groundwater Supplemental Site Inspection Report, June 1997* presents the results of that investigation.

On July 15, 1997, EPA wrote a letter to AFCEE requesting CS-18/CS-19 activities be tolled and that the investigation proceed under the Impact Area Groundwater Study being conducted by NGB.

Discussion of Remedial Objectives

To be determined.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations



Because the screening level risk assessment indicates that nitroaromatic explosive residues, metals, and several organic compounds, including dioxins and furans, are retained as contaminants of concern (COCs) for the soils or groundwater in the vicinity of CS-19, the site should be carried through the remedial investigation/feasibility study (RI/FS) process. The ARNG is currently conducting an investigation of the groundwater in the vicinity of the impact area, including CS-19. It would be in the best interests of all concerned to use the additional data from the impact area investigation to focus the CS-19 RI/FS. This recommendation should be reconsidered in the event that the data from the impact area investigation show that there are other sources of similar contamination in the vicinity of the CS-19 site.

EPA wrote a letter dated July 15, 1997 to AFCEE requesting that site activities be tolled and that further investigation proceed under the impact area study being conducted by NGB.

Statement of the Continued Protection of Human Health and the Environment

The screening level risk assessment indicates that RDX in groundwater must be retained as a COC.

In addition to RDX, the screening risk assessment indicates that the semivolatile inorganic compound (SVOC) bis(2-ethylhexyl)phthalate, the VOC chloroform, and the pesticide alpha-benzene hexachloride (BHC) are also retained as groundwater COCs.

The chemicals of potential concern (COPCs) identified for surface soil are BHC and the furan compounds total HxCDFs. The metal magnesium is the only COPC in the subsurface soil.

There is no indication that the groundwater contaminants have migrated to the edge of the impact area. Thus, the CS-19 contamination does not represent an imminent risk to human health or the environment.



APPENDIX G.5

Site Name: Fuel Spill-2 Railroad Fuel Station**Site Description**

The Railroad Fuel Pumping Station is located at the southern end of Guenther Road, approximately 1,200 feet north of the MMR boundary and 400 feet north of Kittredge Road (Figure 7). AOC FS-2, located in a former railroad yard, is approximately 5.5 acres in size. Engineered structures at the site include former AVGAS and JP-4 jet fuel unloading racks (i.e., headers) and the concrete foundation of the former pumphouse. Both the pumphouse and the railroad spurs leading to the fuel unloading headers were removed from AOC FS-2 before 1985.

The AVGAS and JP-4 unloading headers consist of separate, dedicated 8-inch pipes and couplers. A railroad spur was located immediately south of and parallel to the header pipes. The AVGAS unloading header (with five unloading points), approximately 180 feet long, is located in the eastern half of AOC FS-2. The western JP-4 unloading header (with 10 unloading points) is approximately 380 feet long. Each header system is predominantly below ground, with piping extending to the former pumphouse location. The AOC does not include the two 10-inch fuel transfer lines leaving the site and extending to the MMR Petroleum Fuels Storage Area (PFSA).

AOC FS-2 was used from 1955 to 1965 by the U.S. Air Force (E.C. Jordan Co., 1986). During peak use, as many as 15 railcars a day would transfer fuel to the 10-inch underground pipeline at this location. Fuel trucks with 8,000-gallon capacities would also refuel at this location. Fuel was reportedly spilled in the railbeds, and several gallons were spilled at the unloading racks each time the transfer hoses were disconnected from the header pipes. The ground at AOC FS-2 was reportedly saturated at times; according to the records search information, as much as 10,000 gallons of AVGAS and JP-4 may have been spilled at the site (Metcalf and Eddy, Inc., 1983). After 1965, the Railroad Fuel Pumping Station was no longer used as a fuel transfer point and reportedly was abandoned. Currently, the railroad yard is not vegetated. Thick pine and oak scrub cover part of the southern portion of the site, immediately south of the header pipes.

A baseline risk assessment was conducted at FS-2 for exposures to surface soil and groundwater. Subsequent to remedial investigation activities at FS-2, the Southwest Operable Unit (SWOU) was created in 1997 to address groundwater contamination in the area from LF-1 to CS-10. FS-2 is considered a potential contributor to contaminated groundwater within the SWOU, however all the plumes within the SWOU are detached.

AOC FS-2 was identified in preliminary assessments of MMR because of reported spills of AVGAS and JP-4 jet fuel during fuel transfer operations conducted at the pumping station. The 5.5-acre site encompasses the former railroad spur and unloading header pipes, former pumphouse, and former golf course clubhouse. Areas of potential environmental impact include the header pipes, soils, and groundwater beneath and downgradient of the site. AOC FS-2 was investigated as part of the SI program conducted during fall 1987 and spring/summer 1988 and the RI work conducted during summer/fall 1989 (E.C. Jordan Co., 1989a and 1990c).

On May 8, 1996, the two areas where PAHs were detected in soil samples were excavated generating 520 cubic yards of contaminated soil. The excavated soils were transferred to an



onsite asphalt batching facility constructed and operated during the Drainage Structure Removal Program. The excavated area was filled with soil from the FTA-1 area that had undergone thermal treatment and had been confirmed as below cleanup levels by chemical analysis.

Discussion of Remedial Objectives

Pending, further investigation into subsurface soils in the source area, there are no remedial objectives for FS-2. The excavation of contaminated soil in 1996 eliminated the potential risks identified in the RI Report.

Areas of Noncompliance

There are no areas of noncompliance.

Recommendations

Pending investigation into the subsurface soils in the source area at FS-2 and finalization of the Record of Decision, another five-year review is recommended.

Statement of the Continued Protection of Human Health and the Environment

Based on the baseline risk assessment and the soil removals in 1996, there are no human health or ecological risks posed by the source area at FS-2. Groundwater remedial actions are being addressed through the Southwest Operable Unit.



APPENDIX G.6

Site Name: Fuel Spill-13 Underground Fuel Line Containment (Source Area)

Site Description

FS-13 is located in the Cantonment Area, east of the Connery Avenue Rotary, south of the water tower (Figure 7). The site is divided into unrestricted and restricted areas by a chain-link fence. The unrestricted area extends from the intersection of West Inner Road and North Inner Road, north to North Outer Road. The restricted area, within the flightline operations area, extends north of North Outer Road.

The fuel spill which reportedly occurred at FS-13 was discovered in 1972 when a puddle of fuel was observed at the ground surface during a routine walk-over inspection of an underground fuel supply pipeline. Subsequently, the area was excavated, and a porous section of pipe was replaced. The fuel supply pipeline at FS-13 was historically used for the transport of both aviation gasoline (AVGAS) and JP-4 fuel. When the pipeline was changed from one fuel to the other, a pig was run through the line to clean it out. The pipeline was shut down in 1973, at which time a pig was run through the pipeline one final time to clean out any remaining fuel within the piping. According to the Phase I Records Search (E.C. Jordan, 1986), the leak consisted of approximately 2,000 gallons of JP-4 jet fuel; however, volume and composition of the spill cannot be confirmed.

Field work performed for the SI included a passive soil gas survey, excavation and visual inspection of 800 feet of pipeline in the vicinity of the reported spill, collection of six shallow subsurface soil samples from the trench, collection of five test boring soil samples from the capillary fringe at the water table, and installation and sampling of four monitoring wells.

The SI field program successfully identified and partially delineated an interval of contaminated soils in the capillary fringe above the water table at FS-13, approximately 70 feet below ground surface (bgs). However, the observed soil and groundwater analytical data indicates that contamination at FS-13 is residual. Contaminants above regulatory limits are naphthalene and 2-methylnaphthalene in groundwater and dieldrin in shallow subsurface soil. Ethylene dibromide (EDB) was not detected in any groundwater sample.

The field and analytical data support the concept that FS-13 has undergone significant degradation due to leaching of pure product from source area soils by aquifer recharge as well as active biodegradation.

Further investigation of the site occurred in the FS-28 Southwest Operable Unit (SWOU) Studies. An RI was completed in October 1998 and is currently undergoing regulatory review.

Discussion of Remedial Objectives

A final decision for either source or groundwater associated with FS-13 has not been made, therefore no remedial objectives have been set. Groundwater associated with FS-13 are being addressed as part of the Southwest Operable Unit.



Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

Another five-year review is recommended since a final decision for FS-1 has not been made.

Statement of the Continued Protection of Human Health and the Environment

There is no current exposure risk to humans from contaminated groundwater in Areas 1, 2, and 3 because the exposure pathway is not complete. The human health risk assessment quantified cancer and noncancer risk from future exposure to groundwater within Areas 1, 2, and 3, and current and future risk from exposure to groundwater, surface water, sediment, and ingestion of fish in Area 4. Details of the risk assessment can be found in the draft SWOU RI dated October 1998.



APPENDIX G.7

Site Name: Landfill- 4 Johns Pond Dump-Off Base

Site Description

Landfill No. 4, Johns Pond Dump, is located off base near Johns Pond (Figure 7). This area is a site where contractors dumped waste from concrete and paving operations. During the PA, approximately 18 to 20 rusted 55-gallon drums of undetermined contents were observed. Some of these still contained residue. These drums cannot be identified or linked directly to the military operations at MMR. Asphalt debris, empty tar buckets, and general refuse were also observed in the area of the dump site. Access to the site is unrestricted, and the largest portion of debris is domestic material such as unserviceable household goods, refuse, construction debris, and asphalt. The dump is located adjacent to a trailer park and near a subdivision that is served by private well water supplies.

The following documents contain information regarding the site:

- a. Phase I Records Search (ARNG, ANG, U.S. Air Force, Veterans Administration), Vol. I. Text and Vol. II. Appendices, December 11, 1986.
- b. Site Inspection Report, IRP Task 2-3A, Massachusetts Military Reservation, Vol. I. Text and Vol. II. Appendices, March 1989.
- c. Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns Camp Edwards, Massachusetts, June 25-29 and July 14-15, 1987, USAEHA.
- d. A draft SI work plan was sent to EPA January 20, 1999.

A draft SI report will be generated and sent out for regulatory review once all the analytical data is received and reviewed.

Discussion of Remedial Objectives

Remedial objectives for this site at this stage are to identify the presence or absence of hazardous wastes.

Areas of Noncompliance

There are no known areas of noncompliance.

Recommendations

A site investigation is required at this site along with another five year review.

Statement of the Continued Protection of Human Health and the Environment

The Site Investigation Workplan was delivered to EPA and is undergoing review. Once the site characteristics are known, a statement of continued protection of human health and the environment can be made.



APPENDIX G.8

Site Name: North West Operable Unit

Site Description:

The Main Base Landfill (AOC LF-1) is located in the southern portion of the Range Maneuver and Impact Area, approximately 2 miles from the western and southern borders of the MMR. The landfill occupies approximately 100 acres of open to heavily wooded terrain, and is bounded by Frank Perkins Road to the west, Herbert Road to the north, Turpentine Road to the east, and Connery Road to the south.

AOC LF-1 was operated as the primary solid waste disposal facility at NEMR from 1944 to 1984. Unregulated disposal activities were terminated in 1984, at which time the ANG initiated disposal activity regulation in the Post-1970 cell as a component of the MMR Hazardous Waste Management Plan (CDM, 1996).

Cells 1947, 1951, and 1957 have been grouped into a distinct operable unit known as the NWOU due to their physical similarities and years of operation. The cells encompass approximately 40 acres in the northwestern portion of the landfill and are covered by relatively heavy vegetation (i.e., grass, brush, and trees). An alternate closure plan was recommended for the NWOU cells. The plan consisted of leaving buried wastes in place beneath the existing vegetative cover and providing long-term groundwater monitoring and landfill surface maintenance for 30 years. However, upon regulatory review, it was determined that additional data was needed to characterize the area downgradient of these cells (CDM, 1996; E. C. Jordan 1991). The intent of this Supplemental RI is to provide that additional information.

Two RI programs were conducted at AOC LF-1: a 1989 interim RI program conducted by ABB Environmental Services (ABB-ES), and a 1992-94 program conducted by CDM Federal Programs Corporation (CDM). The interim RI was designed to quantify the groundwater contamination from previous landfill practices and to delineate potential boundaries of any plumes migrating downgradient of the landfill. The RI conducted by CDM was intended to complete the characterization of the extent of subsurface contamination by defining the downgradient and vertical extent of the chlorinated solvent plume originating from AOC LF-1 sources, evaluating the effect of moraine on the plume movement, and determining whether or not the magnetic anomalies detected in the SI at NWOU are sources of groundwater contamination.

Sampling conducted at the NWOU component of the site during the interim RI consisted of collecting groundwater samples from previously installed monitoring wells in the area. Results indicated that the only VOC detected was chloroform at trace levels far below MCLS. Chloroform was also found in many field blank samples and background locations. The only inorganics detected were calcium and sodium, both essential nutrients.

During the 1992-94 RI, four screened-auger borings were installed just downgradient of the NWOU by CDM. Three screened-auger borings were completed along Frank Perkins Road, in the northern portion of the Well Fence, and were advanced to an approximate depth of 80 feet



below the water table. The intent of these borings was to obtain groundwater screening data downgradient from the magnetic anomalies found in the SI. Two of the three borings were completed as water table wells, while the third boring was not completed as a well due to its proximity to existing well MW -705. The fourth boring completed as downgradient monitoring well NM-704, was advanced to a depth of 80 feet below the water table.

During the Final RI, groundwater samples were analyzed for VOCs by EPA Method 524.2 and EDB by EPA Method 504. Low levels of carbon tetrachloride (CC14) and PCE were detected in well MW-61 and a trace concentration of TCE was detected in NM-705 (no VOCs were detected deeper than 10 feet below the water table). Similar concentrations of VOCs (except CC14) were detected in well MW-707 located upgradient of the NWOU (CDM, 1996). Results of the Final RI confirmed findings from previous investigations, i.e.; NWOU was not a source of groundwater VOC contamination.

In addition to VOC analyses, groundwater samples immediately downgradient AOC LF-1 NWOU (MW-61, MW-71, and MW-705) were analyzed for dissolved and total TAL metals and total cyanide. Data indicated that no inorganics exceeded MCLS; however, 18 inorganics (total and/or dissolved) were detected at these downgradient wells in concentrations exceeding NIMR background levels. Therefore, it was suspected that inorganics were leaching from the NWOU. Furthermore, the high total metals versus filtered metals in the Final RI suggested that sorption to fines in the aquifer was occurring. Metals were expected to remain sorbed unless substantial changes in aquifer pH or oxidation-reduction (redox) conditions occurred.

A supplemental RI was performed in December 1996 which further determines the nature and extent of groundwater contamination at NWOU. It establishes the absence of VOC's contamination downgradient of the NWOU and the leaching of iron and manganese into the groundwater the supplemental RI also includes a PRE risk assessment on NWOU.

Discussion of Remedial Objectives:

The objective of the RI and Supplemental RI was to confirm the presence or absence of contamination downgradient of the AOC LF-1 Northwest Operable Unit (NWOU) landfill cells. The Final RI (CDM, 1996) identified this NWOU downgradient data gap and recommended further investigation. This Supplemental RI report summarizes the results of fieldwork completed at Area of Concern (AOC) LF-1 NWOU during the 1996 AOC LF-I Supplemental RI Work Plan Program. It reviews the results and conclusions of previous Site Investigations (SI) and Remedial Investigations (RI) for this area up to the time it was decided by the Otis Installation Restoration Program (IRP) to proceed with this Supplemental RI. It also includes a re-evaluation of baseline risk to human health and the environment posed by exposure to groundwater emanating from the AOC LF-1 NWOU landfill cells. The 1970 cell, the Post-1970 cell, and the kettle hole disposal area are being addressed separately, as part of NGB Plume Containment activities.

Areas of Non Compliance:

There are no areas of non-compliance.

Recommendations:



Results of this Supplemental RI support the absence of VOC contamination downgradient of the NWOU. Iron and manganese, however, appear to be leaching from the NWOU, as indicated by the data. Only manganese was selected as a COC based on screening values for the human health risk assessment. It was concluded that no potential excess risk to future adult residents or workers would result from exposure to manganese in groundwater. The ecological risk assessment evaluated the potential risk to aquatic receptors and the osprey from contaminants in groundwater migrating to surface water. It was concluded that no potential excess risk to aquatic receptors would result from exposure to contaminants in surface water. However, excess risk to the osprey would result from exposure to manganese bioaccumulated in the food chain. Because risks were overestimated by not considering dilution, it is recommended to continue providing long-term groundwater monitoring and landfill surface maintenance for 30 years.

Statement of Continued Protection of Human Health and the Environment:

The human health risk assessment evaluated the potential risk to future adult residents and worker from contaminants in groundwater. Of the four contaminants detected in groundwater, only manganese was selected as a COC based on screening values. The results of the human health risk assessment concluded that no potential excess risk to future adult residents or workers would result from exposure to manganese in groundwater. The ecological risk assessment evaluated the potential risk to aquatic receptors and the osprey from contaminants in groundwater migrating to surface water. The results of the evaluation of risk to aquatic receptors concluded that no potential excess risk would result from exposure to contaminants in surface water. The results of the evaluation of risk to the osprey concluded that excess risk would result from exposure to manganese bioaccumulated in the food chain.

As explained in the Supplemental RI in December 1996, the potential exposure in this PRA is based on conservative assumptions. Realistically, dilution factors will be extremely high. This coupled with chemical, physical, and biological processes will significantly reduce or attenuate currently observed groundwater contaminant levels upon discharge into Buzzards Bay. These conservative assumptions result in an overestimate of actual risk. Accordingly, it is recommended to provide long-term groundwater monitoring and landfill surface maintenance for 30 years.



APPENDIX G.9

Site Name: South East Region Groundwater Operable Unit (SERGOU)

Site Description:

Industrial and military activities in the southeast portion of the Massachusetts Military Reservation (MMR) have released organic and inorganic contaminants to groundwater (Figure 7). This area is the largest industrialized portion of the MMR. Primary sources for contaminants in groundwater are a sump and storage tanks at the Storm Drainage Ditch (SD-5) site, fuel storage tanks and pump houses at the Petroleum Fuels Storage Area (PFSA), and past fire training activities at the Fire Training Area (FTA)-2. Because of the close proximity of the source areas, the groundwater in this area of the MMR was grouped into one operable unit; the Southeast Region Groundwater Operable Unit (SERGOU). In addition to the SERGOU, the Region III hydrogeologic study area, which is off base and located downgradient of SERGOU, was also investigated. A report titled *SouthEast Region Groundwater Operable Unit Remedial Investigations Report (Including Region II) MMR, Draft, August 1994* describes the SERGOU plume.

Discussion of Remedial Objectives:

The purpose of the Remedial Investigation was to identify (1) the nature and distribution of contaminants in SERGOU groundwater, and the nature and distribution of contaminants in surface water and sediment where SERGOU groundwater may discharge, (2) potential migration pathways and receptors for contaminants, and (3) estimated risks posed to human health and the environment based on exposure to the contaminants within SERGOU groundwater. The original purpose of the Region III investigation was to gather the basic geologic and hydrogeologic data needed to evaluate the long-term migration and fate of contaminated groundwater downgradient of SERGOU. However, as investigations in the SERGOU progressed, the Region III investigation was expanded to include the collection and evaluation of chemical data. For the purposes of this report, the SERGOU was divided into four subsets based on source area(s), types of contaminants, location, and the potential that separate remedial actions might be recommended. These subsets are the (1) Western Aquafarm/FTA-2/Landfi-U (LF)-2 groundwater, (2) SD-5 groundwater, (3) PFSA groundwater, and (4) the southeast MMR groundwater. Region III was evaluated as the fifth subset. Based on the groundwater flow from SERGOU, the following four groundwater discharge areas were identified and evaluated: (1) Ashumet Pond, (2) Johns Pond, (3) the cranberry bog north of Ashumet Pond, and (4) the Quashnet River. Both the nature and distribution of contaminants, and the estimated risks were evaluated and are discussed by groundwater subset and groundwater discharge area. The RI presents the results for both the SERGOU and Region III investigations.

Areas of Non Compliance:

There are no areas of non-compliance.

Recommendations:

Groundwater contamination has occurred primarily in the groundwater associated with the Western AquafarTn/FIA-2/LF-2, SD-5, and the PFSA. Additional sporadic groundwater contamination has also occurred in the southeast MMR area. Estimates of both carcinogenic



and/or non-carcinogenic risk for both human health and selected ecological receptors exceed federal and/or state guidelines, however, these estimates of risk are due primarily to inorganic compounds in groundwater and sediments. These inorganic compounds in groundwater are believed to be a results of changing groundwater chemistry (e.g., low dissolved oxygen because of organic contaminant degradation), whereas the inorganic compounds in the sediment may be naturally occurring (e.g., cranberry harvesting, runoff, and recreation). Organic and inorganic compounds were detected at concentrations greater than groundwater MCLS.

Recommendations were made for each individual AOC, which was a component of the SERGOU regional study. More related studies have come out for each of the sites, and supercede information contained in the Draft RI for the SERGOU.

Therefore, going forward the sites should remain individual AOCs with activities and recommendations specific to their characterizations.

Statement of Continued Protection of Human Health and the Environment:

The Draft RI summarizes contaminant finding and associated estimated risks to human health and selected ecological receptors for each groundwater subset and groundwater discharge area. Further reporting has superceded these findings, and the individual sites can be referenced for their statements of continued protection of human health and the environment:

- Western Aquafarm
- Fire Training Area – 2 / Landfill - 2
- Storm Drain - 5 Groundwater
- Petroleum Fuel Storage Area Groundwater

