United States
Environmental Protection
Agency

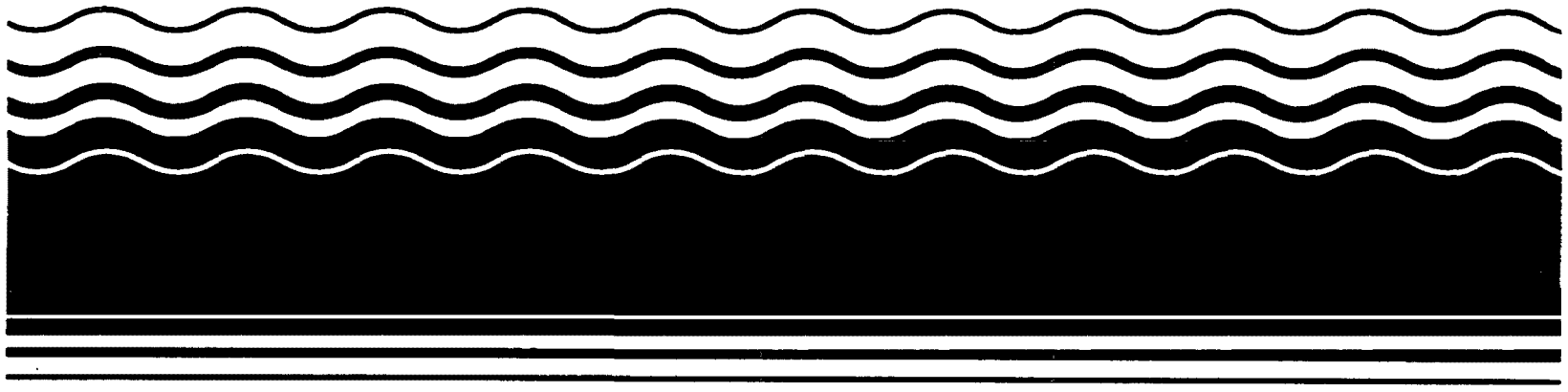
Office of
Emergency and
Remedial Response

EPA/ROD/R01-92/071
May 1992
PB93-963704

EPA

Superfund Record of Decision:

Otis Air National Guard/Camp Edwards, MA



NOTICE

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R01-92/071	2.	3. Recipient's Accession No.

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SUPERFUND RECORD OF DECISION
Otis Air National Guard/Camp Edwards, MA
First Remedial Action - Interim

5. Report Date 05/20/92

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PB93-963704

16. Abstract (Limit: 200 words)
The 22,000-acre Otis National Guard/Camp Edwards site is a former military vehicle maintenance facility on Cape Cod, Massachusetts, within the Massachusetts Military Reservation (MMR). The Area of Contamination Chemical Spill Area Number 4 (AOC CS-4) plume extends 11,000 feet and is located 1.1 miles from the southern boundary of MMR. Land use surrounding MMR is predominantly residential and light industrial. Ground water beneath Cape Cod has been classified as a Class I, Sole Source Aquifer under the Safe Drinking Water Act. From 1940 to 1984, the site was used by the Federal Government for various purposes. From 1940 to 1946, the U.S. Army operated the site for maintenance of military vehicles, and from 1955 to 1973, the USAF operated the vehicle area. Wastes and equipment handled at AOC CS-4 included oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels. Additionally, the northern portion of AOC CS-4 was used as a storage yard for wastes generated by shops and laboratories operating at MMR. Liquid wastes were stored in containers or underground storage tanks (USTs) in an unbermed area or deposited in USTs designated for motor gasoline. The UST waste storage contents were removed in 1984, and the AOC CS-4 site has been inactive since 1986. Since 1986, the DOD's Installation Restoration Program

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Otis Air National Guard/Camp Edwards, MA
First Remedial Action - Interim
Contaminated Medium: gw
Key Contaminants: VOCs (PCE, TCE)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 82
	20. Security Class (This Page) None	22. Price

EPA/ROD/R01-92/071
Otis Air National Guard/Camp Edwards, MA
First Remedial Action - Interim

Abstract (Continued)

staff has conducted several investigations at MMR, which revealed that ground water was contaminated with VOCs and may migrate off of the MMR to the south. This ROD addresses OU2, the interim action for MMR AOC CS-4 ground water to prevent further down gradient migration of the contaminants. Future RODs will address a final remedy for the AOC CS-4 plume upon completion of the AOC CS-10 ground water plume study, while contaminated soil will be addressed as part of a removal action. The primary contaminants of concern affecting the ground water are VOCs, including PCE and TCE.

The selected remedial action for this site includes onsite pumping and treatment of 790 million gallons of contaminated ground water using carbon adsorption to remove VOCs; monitoring the influent and effluent of the carbon absorption treatment, and discharging the treated water to an onsite infiltration trench; and monitoring ground water. The estimated present worth cost for this remedial action ranges from $2,113,000 to $4,528,000, which includes a present worth O&M cost ranging from $472,000 to $1,012, 000 for 5 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific clean-up goals for ground water are based on SDWA MCLs and state standards and include PCE 5 ug/l, and TCE 5 ug/l, (10^{-6} risk-based standard).

INSTALLATION RESTORATION PROGRAM

RECORD OF DECISION
INTERIM REMEDIAL ACTION
WEST TRUCK ROAD MOTOR POOL (AOC CS-4)
GROUNDWATER OPERABLE UNIT

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

FINAL

MAY 1992

HAZWRAP SUPPORT CONTRACTOR OFFICE
Oak Ridge, Tennessee 37831
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-840R21400

INSTALLATION RESTORATION PROGRAM

RECORD OF DECISION
INTERIM REMEDIAL ACTION
WEST TRUCK ROAD MOTOR POOL (AOC CS-4)
GROUNDWATER OPERABLE UNIT

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

FINAL

Prepared for:

HAZWRAP Support Contractor Office
Oak Ridge, Tennessee

Managed by:

Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy
Under Contract No. DE-AC05-840R21400

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine
Project No. 7030-04

MAY 1992

AOC CS-4 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

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MASSACHUSETTS MILITARY RESERVATION

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1.0 DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

The Massachusetts Military Reservation (MMR) on Cape Cod, Massachusetts, lies within the boundaries of Falmouth, Mashpee, Sandwich, and Bourne. The Area of Contamination (AOC) Chemical Spill Area No. 4 (CS-4) source area is located 1.1 miles from the southern MMR boundary on the northwestern side of West Truck Road. The AOC CS-4 groundwater plume extends approximately 11,000 feet from the source area.

STATEMENT OF BASIS AND PURPOSE

This document presents the selected interim remedial action for MMR AOC CS-4 groundwater chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the administrative record file for this site, which was developed in accordance with Section 113(k) of CERCLA and which is available for public review at the information repositories located at (1) the Falmouth Public Library, Falmouth, Massachusetts; (2) the Air National Guard (ANG) Environmental Management Office at Otis ANG Base, Massachusetts; and (3) the U.S. Environmental Protection Agency (USEPA) Regional Office at 90 Canal Street, Boston, Massachusetts. The attached index identifies the items comprising the Administrative Record upon which the selection of a remedial action is based (see Appendix A). The Commonwealth of Massachusetts statement of concurrence with the selected remedy is presented in Appendix B.

ASSESSMENT OF AOC CS-4 GROUNDWATER

Actual or threatened releases of hazardous substances from this AOC, if not addressed by implementing the response action selected in this Record of Decision (ROD), may pose an imminent and substantial endangerment to human health, welfare, or the environment.

DESCRIPTION OF THE SELECTED INTERIM REMEDY

In summary, the interim remedy consists of the following:

- extracting contaminated groundwater at the leading edge of the plume
- pumping the extracted groundwater to a treatment plant
- removing volatile organic compounds (VOC) by carbon adsorption treatment
- discharging treated groundwater to an infiltration trench located crossgradient at MMR
- installing observation wells to monitor the hydraulic performance of the extraction system
- installing groundwater monitoring wells upgradient of the discharge area
- sampling existing monitoring wells, monitoring wells to be installed upgradient of the discharge area, and some of the proposed observation wells to monitor the plume's flowpath and chemical concentrations
- monitoring the influent and effluent of the carbon adsorption treatment
- reviewing the site after five years of operation

This operable unit interim remedial action will intercept the AOC CS-4 groundwater plume to prevent further downgradient migration of the contaminants. Extraction and treatment will continue until the final remedy for the site is chosen. Selection of a final remedy will depend on the study of the AOC CS-10 groundwater plume that has been identified upgradient from the AOC CS-4 plume. The interim and final remedies must be consistent with the clean-up goals established for the entire MMR site. The National Guard Bureau (NGB) long-term clean-up goals for reducing contamination in the groundwater at MMR are to meet federal Maximum Contaminant Levels (MCLs), federal Maximum Contaminant Level Goals (MCLGs), Massachusetts MCLs, or risk-based guidance levels for compounds for which drinking water standards have not been set.

STATUTORY DETERMINATIONS

The interim action is protective of human health and the environment, complies with federal and state Applicable or Relevant and Appropriate Requirements (ARARs) for this limited scope action, and is cost-effective. Although this interim action is not intended to fully address the statutory mandate for permanence and treatment to the maximum extent practicable, this interim action uses treatment and thus is in furtherance of that statutory mandate. Because this action does not constitute the final remedy for the AOC CS-4 groundwater, the statutory preference for remedies that employ treatment that reduces mobility, toxicity, or volume as a principal element, although partially addressed in this remedy, will be addressed by the final response action. Subsequent actions are planned to fully address the threats posed by conditions at this operable unit. Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after commencement of the remedial action. Because this is an interim action ROD, review of this site and this remedy will be continuing as the NGB continues to develop final remedial alternatives for the AOC CS-4 groundwater operable unit.

The foregoing represents the selection of an interim remedial action by the Department of Defense, NGB, and USEPA Region I, with concurrence of the Commonwealth of Massachusetts.

Department of Defense, NGB

By: _____ Date: May 20, 1992

Ronald Watson, P.E.
Chief, Environmental Division

U.S. Environmental Protection Agency, Region I

By: _____ Date: May 20, 1992

Julie Belaga
Regional Administrator

2.0 SITE NAME, LOCATION, AND DESCRIPTION

MMR is a National Priorities List (NPL) Superfund site. There are currently 77 areas within MMR that are under investigation. Some of these areas have been grouped into medium-specific operable units for remediation purposes. This ROD relates to the interim remedial action for the AOC CS-4 groundwater plume, which was the result of past contamination from AOC CS-4.

MMR, which lies within the boundaries of Bourne, Falmouth, Mashpee, and Sandwich, Massachusetts, occupies approximately 22,000 acres (Figure 2-1) and consists of several cooperating command units: ANG, Army National Guard, U.S. Air Force (USAF), Veterans Administration, and U.S. Coast Guard. The site is described in more detail in the focused feasibility study (FFS). The USAF managed the base until 1973, when base management was transferred to the ANG.

The U.S. Department of Defense (DOD) initiated a multiphase Installation Restoration Program (IRP) to identify and evaluate problems associated with past hazardous waste disposal and spills at DOD installations, including ANG facilities.

The NGB is proposing an interim remedial plan, referred to as a preferred alternative, to address AOC CS-4 groundwater contamination (Figure 2-2). This ROD recommends a method of addressing contamination associated with AOC CS-4 groundwater from the containment options evaluated during the FFS (ABB Environmental Services, Inc., 1992a).

Property usage surrounding MMR is primarily residential and light industrial in each of the surrounding towns.

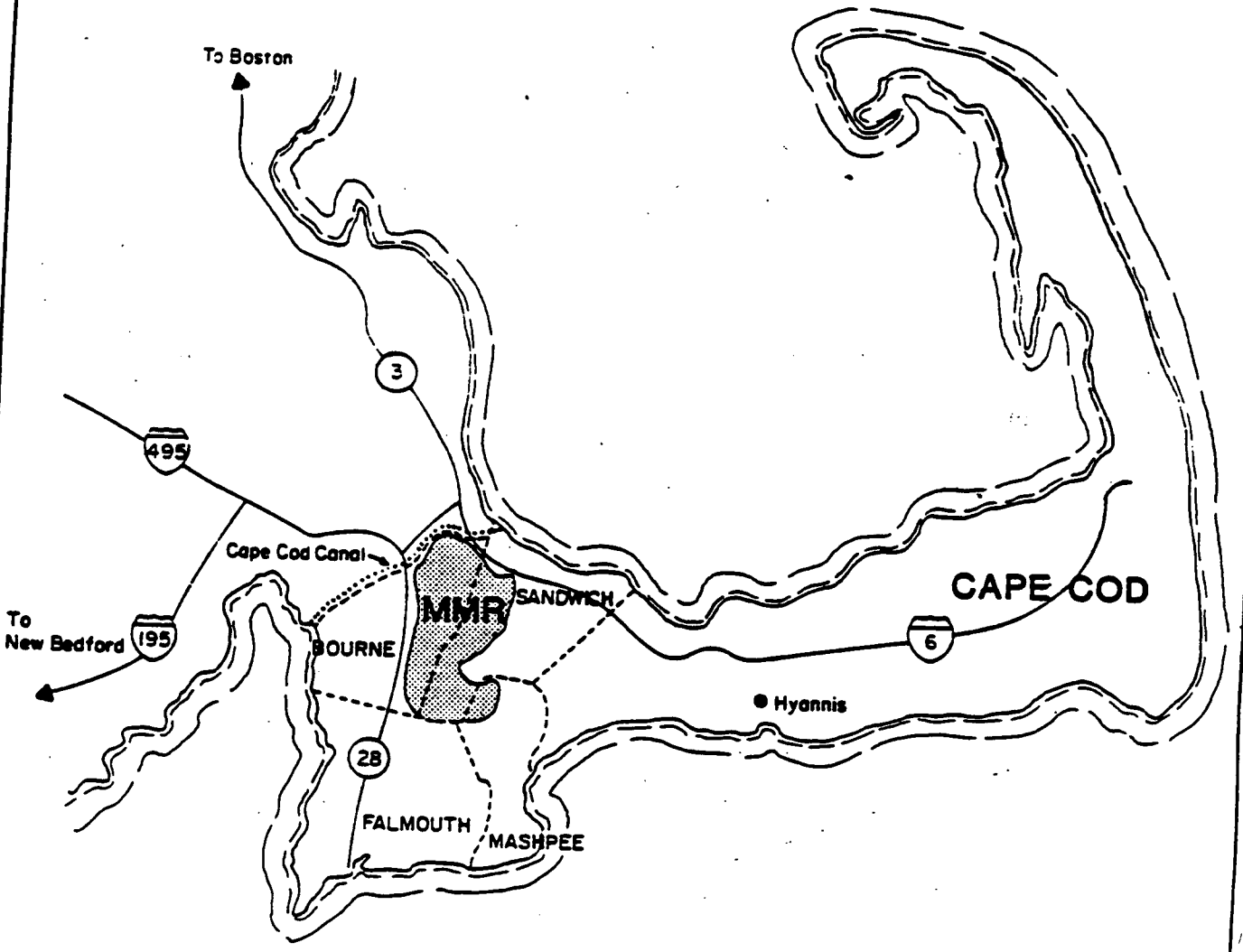
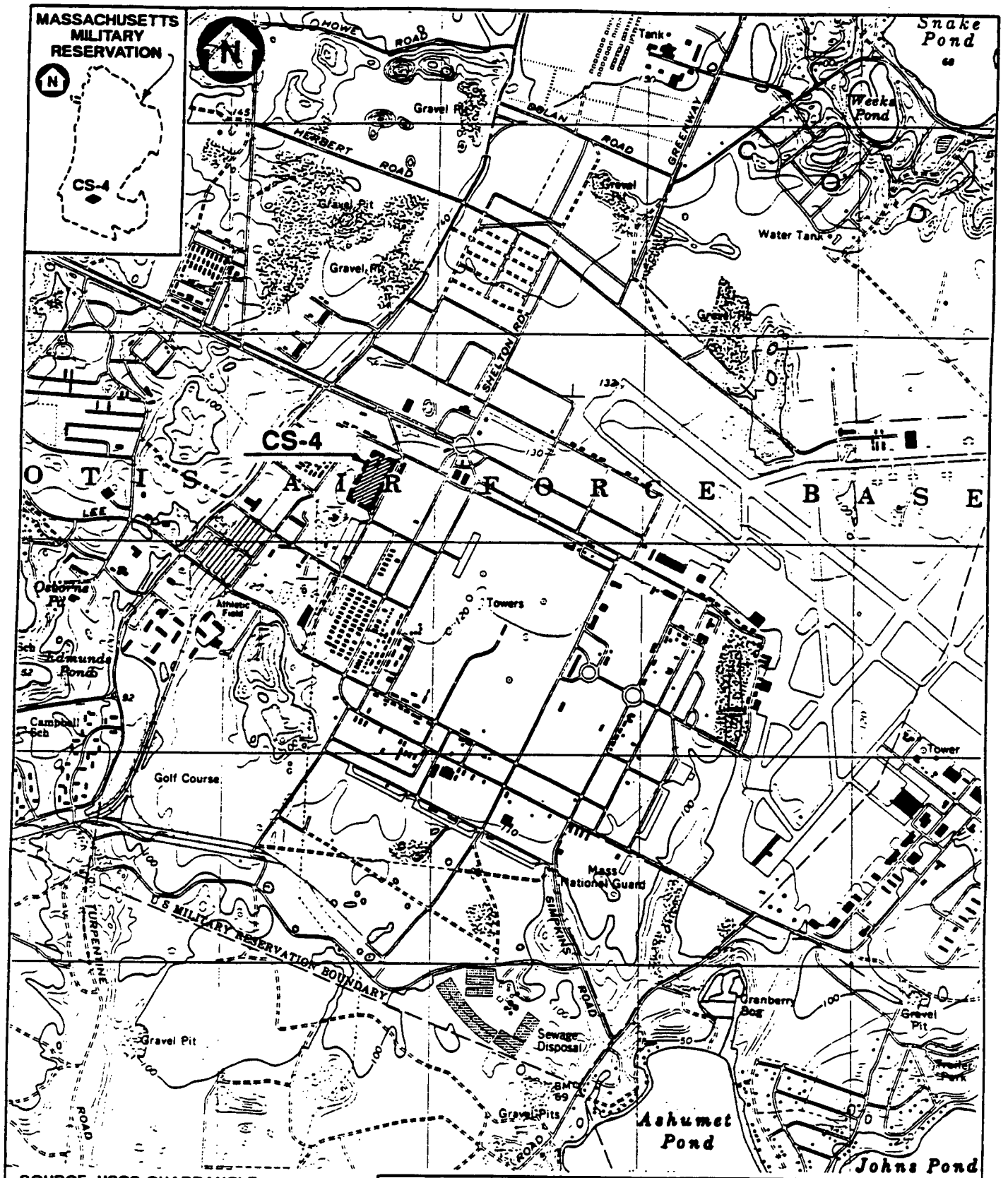


ABB Environmental Services, Inc.	SITE LOCATION MAP	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	AOC CS-4 ROD	FIGURE 2-1

NOT TO SCALE

7001-05



SOURCE: USGS QUADRANGLE, POCASSET, MA., 7.5 MINUTE SERIES

NOTE: CS = CHEMICAL SPILL

SCALE IN FEET

0 2,000 4,000

ABB Environmental Services Inc.

ASEA BROWN BOVERI

AOC CS-4
SOURCE LOCATION MAP

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

AOC CS-4
ROD

FIGURE 2-2

7030-04

3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

In accordance with Section 117(a) of CERCLA, the NGB is publishing this ROD to address public review and comment on the selected interim containment alternative, known as a remedial alternative, considered for AOC CS-4 as the interim remedy. The NGB, in consultation with USEPA, considered public comments as part of the final decision-making process for selecting the remedy for AOC CS-4 groundwater. This ROD summarizes results and conclusions of the FFS and the Proposed Plan.

In response to environmental contamination that has occurred as a result of the use, handling, storage, or disposal of hazardous materials at many military installations across the United States, the DOD initiated investigation and clean-up activities under the IRP. The IRP parallels the Superfund program and is conducted in the following seven stages:

- identification of potential hazardous waste sites
- confirmation of the presence of hazardous materials at the site
- determination of the type and extent of contamination
- evaluation of alternatives for clean up of the site in the FFS
- proposal of a clean-up remedy in the Proposed Plan
- selection of a remedy
- implementation of the remedy for clean up of the site

Both private sector and federal facility sites are eligible for placement on the USEPA NPL, which is used to prioritize investigations and responses at hazardous waste sites. MMR was added to the NPL on November 21, 1989. Private sector sites placed on the NPL are eligible to receive funding from the nation's environmental trust fund (i.e., Superfund), and are often called Superfund sites. Federal military facilities such as MMR receive funding from the DOD Defense Environmental Restoration Account.

3.1 LAND USE AND RESPONSE HISTORY

AOC CS-4 was operated for the 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 include oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels.

In addition to motor pool activities, the base Defense Property Disposal Office (DPDO) maintained a storage yard in the northern portion of AOC CS-4 between 1965 and 1983. Wastes were transported to the DPDO from shops and laboratories operating at MMR. Wastes and equipment handled at AOC 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 underground storage tanks (USTs) installed to store motor gasoline when the motor pools were operational. The 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.

Since January 1986, several site investigations have been conducted at MMR as part of the IRP. Initially, AOC CS-4 was studied by the U.S. Army Environmental Hygiene Agency (AEHA) to assess the impact of base DPDO activities on local groundwater quality. Results of that study prompted AEHA to include the remaining motor pool area in the investigation. AOC CS-4 was further investigated in the preliminary assessment of MMR in 1986, and again in 1988 (E.C. Jordan Co., 1986 and 1990a).

In 1987, several multilevel monitoring wells were installed along the MMR boundary, including monitoring well cluster MW-603. Data obtained from these investigations suggest that contaminated groundwater may be migrating off MMR from some of the sites. In particular, groundwater contamination may migrate off MMR in a south-southwesterly direction from AOC CS-4, as indicated by monitoring well cluster MW-603, located along the southern MMR boundary.

The 1989 Phase I MW-603 groundwater study was conducted to determine the extent of groundwater contamination detected in the MW-603 cluster, primarily tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,2-dichloroethylene (DCE), and to provide more data to link AOC CS-4 with contaminants in MW-603. This study concluded that chlorinated solvents were associated with soil contamination found at the AOC CS-4 source area and had migrated off-MMR toward potential groundwater receptors (E.C. Jordan Co., 1990c).

Phase I of the MW-603 groundwater study determined the extent of groundwater contamination and identified the source area. Phase I also identified the need for better hydrogeologic data to assess the feasibility of remediating the groundwater plume. Conducted in the spring of 1990, Phase II of the MW-603 groundwater study was an aquifer pumping test to gather these hydrogeologic data (E.C. Jordan Co., 1990b). Using these hydrogeologic data, the FFS was prepared to evaluate the interim remedial alternatives for containing the AOC CS-4 groundwater plume.

3.2 ENFORCEMENT HISTORY

The NGB has followed USEPA guidelines for most of the IRP investigations conducted at MMR since 1986 and for all investigations completed since 1989. Placement on the NPL has not necessitated substantive changes in the overall technical approach to remediation studies. However, upon formalization of the NPL status, the NGB entered into an Interagency Agreement with USEPA and U.S. Coast Guard on July 17, 1991, to define responsibilities, documentation requirements, and future regulatory interaction regarding remedial activities at MMR under CERCLA authority. The ANG is the NGB component directly responsible for carrying out NGB's responsibilities under the agreement.

4.0 COMMUNITY PARTICIPATION

Throughout MMR's history, community concern and involvement has been high. The NGB and USEPA have kept the community and other interested parties apprised of site activities through informational meetings, fact sheets, press releases, public hearings, and Technical Environmental Affairs Committee (TEAC) meetings. The TEAC was organized in 1986 by NGB to provide a forum for public input on MMR remedial response activities. Membership on the TEAC comprises USEPA, Massachusetts Department of Environmental Protection (MADEP), and representatives from local, regional, and state groups.

During July 1991, the MMR community relations plan was released; this outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. On February 24, 1992, the NGB held an informational meeting at Lawrence Junior High School in Falmouth, Massachusetts, to describe the FFS and Proposed Plan.

On February 24, 1992, the NGB made the administrative record available for public review at NGB's IRP Office, Otis ANG Base, Massachusetts; USEPA's offices in Boston, Massachusetts; and the Falmouth Public Library, Falmouth, Massachusetts. The NGB published a notice and brief analysis of the Proposed Plan in the *Cape Cod Times*, *Bourne Courier*, and *Sandwich Broadsider* on February 20, 1992, and in the *Falmouth Enterprise* and *Mashpee Enterprise* on February 21, 1992. The NGB made the FFS and Proposed Plan available to the public at Falmouth Public Library and the administrative records locations.

On February 24, 1992, the NGB held an informational meeting to discuss the results of the field investigations and the clean-up alternatives presented in the FFS and to present the Proposed Plan. Also during this meeting, the NGB answered questions from the public. From February 25 to March 25, 1992, the NGB held a 30-day public comment period to accept public comments on the alternatives presented in the FFS and the Proposed Plan. On March 18, 1992, the NGB held a public hearing to discuss the Proposed Plan and to accept any oral comments. A transcript of this hearing, the written comments received, and the NGB's responses to the comments are included in the responsiveness summary (see Appendices C, D, and E).

5.0 SCOPE AND ROLE OF RESPONSE ACTION

The selected remedy was developed by combining components of different containment alternatives to obtain a comprehensive approach for remediation of AOC CS-4 groundwater. The selected remedy is an interim remedy. An interim remedy is designed to take action to protect human health and the environment in the short term while additional information is collected to better assess the aquifer's and contaminant's responses to remediation efforts. The interim remedy will operate for a minimum of five years, after which time a final remedial action will be developed. A final ROD for groundwater will be based on the data collected during the design, operation, and monitoring of the interim remedy and the findings of further characterization of the CS-10 plume. Additional interim remedial actions may be proposed if data collected prior to the final ROD warrant it.

In summary, the interim remedy provides for (1) extracting contaminated groundwater at the leading edge of the CS-4 groundwater plume for a minimum of five years; (2) pumping the extracted groundwater to a proposed treatment plant to remove contaminants by carbon adsorption; (3) discharging the treated groundwater to infiltration trenches located crossgradient from the plume at MMR; (4) installing observation wells to monitor the hydraulic performance of the extraction system; (5) sampling existing monitoring wells and some of the proposed observation wells to monitor the plume's flowpath and contaminant concentrations; (6) monitoring the influent and effluent of the carbon adsorption treatment; (7) monitoring proposed monitoring wells upgradient of the discharge area; and (8) reviewing the site after five years of operation. This operable unit interim remedial action will intercept the CS-4 groundwater plume to prevent further downgradient migration of contaminants. An additional contaminated groundwater plume, CS-10, has been identified upgradient of the CS-4 plume. The interim remedial action will allow time for the CS-10 plume to be characterized and a final remedial action to be designed that will be consistent with the interim action and the NGB's long-term clean-up goals for reducing contamination in the groundwater at MMR.

The interim remedial action will address the following objectives:

- Reduce potential risk associated with ingestion of contaminated groundwater to acceptable levels.

- Protect uncontaminated groundwater and surface water for future use by minimizing the migration of contaminants.
- Reduce the time required for aquifer restoration.

6.0 SUMMARY OF SITE CHARACTERISTICS

Section 2.0 of the FFS is an overview of the environmental contamination assessment (ABB Environmental Services, Inc., 1992a). The significant findings of the investigations and environmental contamination assessment are summarized in this section.

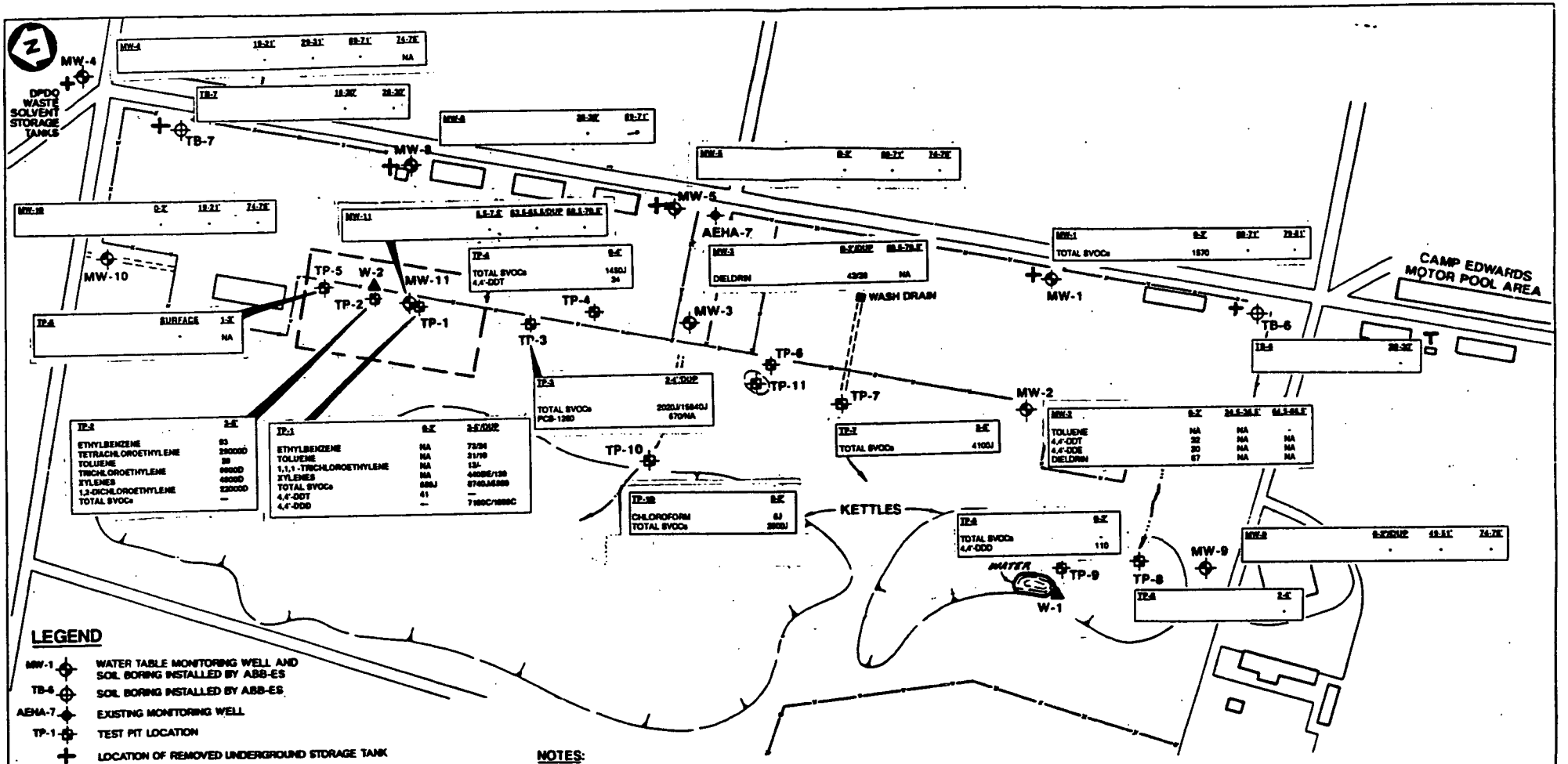
6.1 SOIL CONTAMINATION ASSESSMENT

The primary focus of the environmental contamination assessment is groundwater contamination at AOC CS-4. Because soil contamination has been identified as the source of groundwater contamination, soil contamination is reviewed herein. The soil contamination assessment summarizes the results of field work conducted as Tasks 2-3B and 2-5B during the spring and summer of 1988 and the fall of 1989, respectively (E.C. Jordan Co., 1990a and 1990d).

The primary soil contaminants at AOC CS-4 appear to be PCE, TCE, and 1,2-DCE. Concentrations as high as 130,000 micrograms per kilogram (μg/kg) of PCE and 100,000 μg/kg of TCE were detected in a layer of silty fill soils along the western edge of the site. The greatest concentrations are limited to an area approximately 150 by 6 feet (ABB Environmental Services, Inc., 1991). Figures 6-1 and 6-2 illustrate the spatial distribution and extent of contaminants encountered in AOC CS-4 source area soils.

To understand the potential for AOC CS-4 soil contamination to leach to groundwater, the USEPA Organic Leachate Model (OLM) and modified Summer's model were utilized (USEPA, 1986 and 1989). The AOCs CS-4, FS-25, and FTA-1 engineering evaluation/cost analysis (EE/CA) report discusses the modeling analysis, which indicates that leaching from AOC CS-4 soil would be expected to impact groundwater as observed at the sites (ABB Environmental Services, Inc., 1991).

The source of groundwater contamination appears to be residual chemicals in soils at AOC CS-4. Evaluation of the leaching potential of these soils using the OLM suggests that concentrations in soils at the source area are sufficient to produce the



LEGEND

- MW-1 — WATER TABLE MONITORING WELL AND SOIL BORING INSTALLED BY ABB-ES
- TB-6 — SOIL BORING INSTALLED BY ABB-ES
- AEHA-7 — EXISTING MONITORING WELL
- TP-1 — TEST PIT LOCATION
- LOCATION OF REMOVED UNDERGROUND STORAGE TANK
- LOCATION OF UNDERGROUND STORAGE TANK (IN USE)
- FENCE LINES (EXISTING OR ABANDONED)
- SOIL GAS EXPLORATION PROGRAM
- WATER SAMPLING LOCATION

SCALE IN FEET

0 200 400

NOTES:

ORGANIC RESULTS IN MICROGRAMS PER KILOGRAM
INORGANIC RESULTS IN MILLIGRAMS PER KILOGRAM

- J CONCENTRATIONS LESS THAN CONTRACT REQUIRED DETECTION LIMIT
- E VALUE ESTIMATED DUE TO INTERFERENCE
- - NOT DETECTED
- NA NOT ANALYZED
- C CONFIRMED BY MASS SPECTROMETRY
- B PARAMETERS DETECTED IN BLANK
- • NO PARAMETERS DETECTED IN SAMPLE
- D SAMPLE DILUTED
- X

AREA OF FIGURE 2-2

ABB Environmental Services Inc.

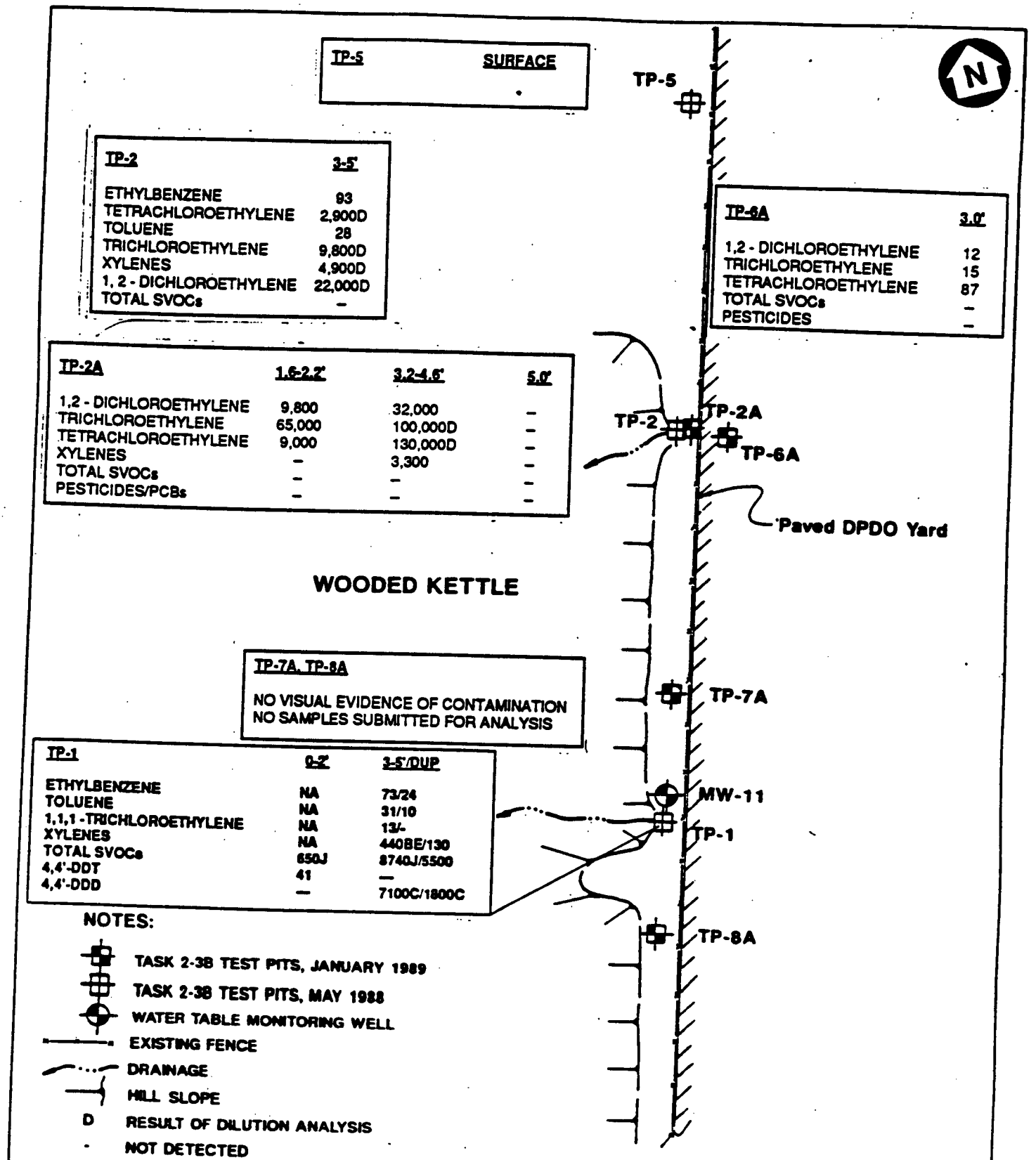
SOIL ORGANIC ANALYTICAL RESULTS

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

AOC CS-4 ROD

FIGURE 6-1

7001-05


TP-5 SURFACE
TP-5
TP-2 3-5'
ETHYLBENZENE 93
TETRACHLOROETHYLENE 2,900D
TOLUENE 28
TRICHLOROETHYLENE 9,800D
XYLENES 4,900D
1, 2 - DICHLOROETHYLENE 22,000D
TOTAL SVOCs –
TP-6A 3.0'
1,2 - DICHLOROETHYLENE 12
TRICHLOROETHYLENE 15
TETRACHLOROETHYLENE 87
TOTAL SVOCs –
PESTICIDES –
TP-2A 1.6-2.2' 3.2-4.6' 5.0'
1,2 - DICHLOROETHYLENE 9,800 32,000 –
TRICHLOROETHYLENE 65,000 100,000D –
TETRACHLOROETHYLENE 9,000 130,000D –
XYLENES – 3,300 –
TOTAL SVOCs – – –
PESTICIDES/PCBs – – –
TP-2
TP-2A
TP-6A
Paved DPDO Yard
WOODED KETTLE
TP-7A, TP-8A
NO VISUAL EVIDENCE OF CONTAMINATION
NO SAMPLES SUBMITTED FOR ANALYSIS
TP-7A
TP-1 0-2' 3-5'/DUP
ETHYLBENZENE NA 73/24
TOLUENE NA 31/10
1,1,1 -TRICHLOROETHYLENE NA 13/-
XYLENES NA 4408E/130
TOTAL SVOCs 650J 8740J/5500
4,4'-DDT 41 —
4,4'-DDD — 7100C/1800C
MW-11
TP-1
TP-8A
NOTES:
TASK 2-3B TEST PITS, JANUARY 1989
TASK 2-3B TEST PITS, MAY 1988
WATER TABLE MONITORING WELL
EXISTING FENCE
DRAINAGE
HILL SLOPE
D RESULT OF DILUTION ANALYSIS
- NOT DETECTED
RESULTS IN ug/kg
* NO PARAMETERS DETECTED IN SAMPLE
SCALE IN FEET
0 50 100
ABB Environmental Services, Inc.
ASEA BROWN BOVERI
ADDITIONAL SOIL ANALYTICAL RESULTS
INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION
AOC CS-4 ROD
FIGURE 6-2
7001-05

observed groundwater contamination. Remediation of the AOC CS-4 source area is the subject of a separate document (ABB Environmental Services, Inc., 1991).

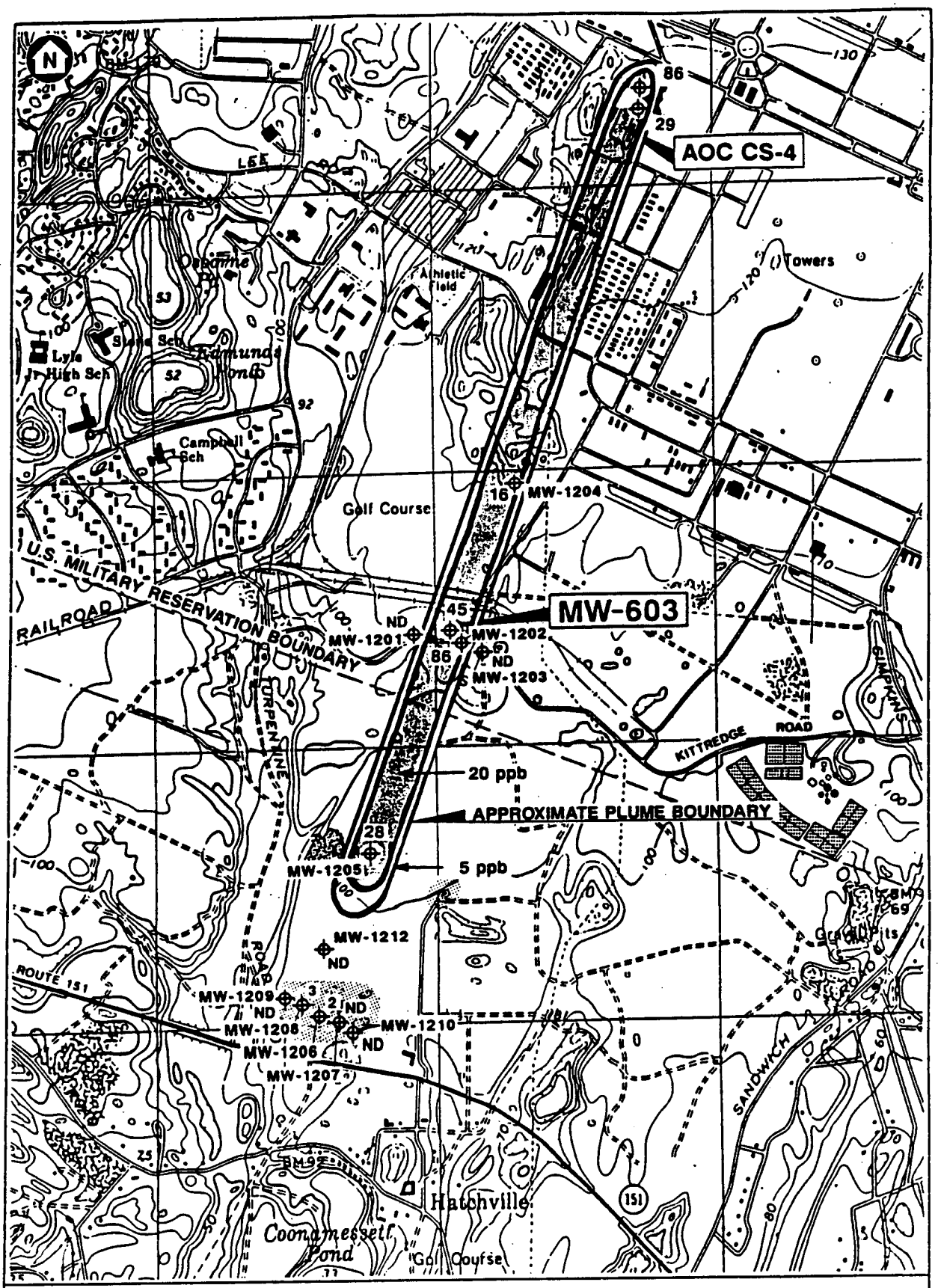
6.2 GROUNDWATER CONTAMINATION ASSESSMENT

The groundwater contamination assessment discusses results of investigations that began in 1985 with the AEHA and continued until 1990 with ABB Environmental Services, Inc. The study of groundwater related to AOC CS-4 evolved from two studies. Groundwater at AOC CS-4 was investigated as part of Tasks 2-3A and 2-3B and Phases I and II of the MW-603 groundwater study (E.C. Jordan Co., 1989a, 1990a, 1990b, and 1990c). The Phase I MW-603 groundwater study provided the link between the downgradient groundwater plume and the AOC CS-4 source area.

A profile of the AOC CS-4 groundwater operable unit plume was generated from data gathered during the investigative studies. Figure 6-3 illustrates the horizontal extent of groundwater contamination. The area where contaminant concentrations exceed 5 micrograms per liter (μg/L) extends from beneath AOC CS-4, 11,000 feet downgradient to within 1,200 feet north of Route 151. The lateral width of the CS-4 groundwater operable unit is approximately 800 feet; its thickness in profile is approximately 40 feet. The estimated plume volume with concentrations equal to or greater than 5 μg/L is 790 million gallons (assuming 30 percent aquifer porosity).

The plume is located near the water table at AOC CS-4. Influenced by rainfall accretion, the plume moves deeper into the aquifer with distance from the source. At MW-603, the plume is approximately 75 feet below the water table. At MW-1206, where only trace concentrations are detectable, the plume is estimated to be 85 feet below the water table.

The primary chemicals detected in the CS-4 groundwater operable unit are PCE (at concentrations up to 62 μg/L) and TCE (at concentrations up to 32 μg/L). DCE has been detected in groundwater at the AOC CS-4 source area at concentrations up to 26 μg/L. 1,1,2,2-Tetrachloroethane has been detected at concentrations as high as 24 μg/L in downgradient monitoring wells. Tables 6-1 through 6-5 summarize results of the groundwater investigations as presented in the FFS.



LEGEND

1.5 SUM OF TRICHLORETHYLENE(TCE) AND TETRACHLOROETHYLENE (PCE) (MICROGRAMS PER LITER)

ESTIMATED LOCATION OF >5 ug/LTCE + PCE CONCENTRATION

BASE MAP SOURCE: USGS MAPS
FALMOUTH, MASS. DATED 1972 (Photorevised 1979) &
POCASSET, MASS. DATED 1967 (Photorevised 1979)

SCALE IN FEET
0 1,000 2,000

ABB Environmental Services Inc.

AOC CS-4
GROUNDWATER PLUME

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

AOC CS-4 ROD

FIGURE 6-3

7001-05

TABLE 6-1
SUMMARY OF AEHA GROUNDWATER ANALYTICAL DATA

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MONITORING WELL	ANALYSIS													
	ARSENIC	BORON	BARIUM	CALCIUM	CADMIUM	IRON	POTASSIUM	MAGNESIUM	MANGANESE	SODIUM	NICKEL	ZINC	NITRITE - NITRATE	PHENOL
AEHA-6	–	–	–	2,100	13	142	–	1,870	221	5,100	–	41	180	–
AEHA-7	31*	112*	29*	8,000*	–	2,300	840	3,120*	599*	10,500*	–	42*	1,800*	–
AEHA-8	–	86	12	3,070	–	3,500*	1,120*	2,770	572	7,100	86	21	–	10*
RANGE	ND-31	ND-112	ND-29	ND-8,000	ND-13	142-3,500	ND-1,120	1,870-3,120	221-599	5,100-1,050	ND-86	21-42	ND-1,800	ND-10
MCLs	5	–	1,000	–	10	–	–	–	–	–	–	–	10,000	–

Notes:

All values reported as micrograms per liter (µg/L).
Modified after AEHA (1986)

– = Not Detected
* = Highest Detection
ND = Non-Detect
AEHA = U.S. Army Environmental Hygiene Agency
MCL = Maximum Contaminant Level

Source: AEHA, 1986

TABLE 6-2
TASK 2-3B SOURCE AREA GROUNDWATER ANALYTICAL DATA SUMMARY

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MONITORING WELL	ANALYSIS			
	TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS			TARGET ANALYTE LIST INORGANICS
	TETRACHLOROETHYLENE	1,2-DICHLOROETHYLENE (TOTAL)	TRICHLOROETHYLENE	SODIUM
AEHA-6	--	--	--	--
AEHA-7	--	--	--	--
AEHA-8	--	--	--	--
MW-1	--	--	--	--
MW-2	--	--	--	6,630E
MW-3	19	4E	6	7,990E
MW-4	5	--	--	9,140E
MW-5	8	--	--	--
MW-8	4E	--	--	8,360E
MW-9	--	--	--	5,240E
MW-10	--	--	--	15,100E*
MW-11	37*	26*	23*	--
RANGE	ND-37	ND-26	ND-23	ND-15,100E

Notes:

All values reported in micrograms per liter (µg/L)
E = Estimated Concentration
-- = Not Detected
ND = Non-Detect
* = Highest Site Detection of Analyte
Sampling Date: 3/90 to 4/90
Semivolatile organic compounds were not detected.

Source: E.C. Jordan Co., 1990a.

TABLE 6-3
TASK 2-5B SOURCE AREA GROUNDWATER ANALYTICAL DATA SUMMARY

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

NITORING WELL	ANALYSIS				
	TOTAL COMPOUND LIST VOLATILE ORGANIC COMPOUNDS				TOTAL SVOCs
	TETRACHLOROETHYLENE	1,2-DICHLOROETHYLENE (TOTAL)	TRICHLOROETHYLENE	1,1,2,2-TETRACHLOROETHANE	BIS(2-ETHYLHEXYL)PHTHALATE
HA-6	–	–	–	–	–
HA-7	6J	–	–	–	–
HA-8	1J	–	–	–	–
/-1	–	–	–	–	–
/-2	–	–	–	–	–
/-3	9	1	3	–	–
/-4	4	–	–	–	–
/-5	6	–	–	–	–
/-8	3	–	–	–	12
/-9	–	–	–	–	–
/-9A	–	–	–	–	–
/-10	–	–	–	–	–
/-11	38*	21*	30*	–	15*
-12	–	–	1	–	–
/-13	7	–	1	–	–
/-603Z	–	–	–	–	–
/-603A	50*	–	26*	22*	–
/-603B	–	–	–	10	–
/-603C	–	–	–	–	–
/-603D	–	–	–	–	–
/-603E	–	–	–	–	–
NGE	ND-50	ND-21	ND-30	ND-22	ND-15

es:

alues reported in micrograms per liter (µg/L)
= Concentration less the Contract Required Detection Limit
= Not Detected
= Highest Site Detection of Analyte
= Non-Detect
)C = Semivolatile Organic Compound

W003929.T80/5

TABLE 6-4
TASK 2-3A DOWNGRADIENT GROUNDWATER ANALYTICAL DATA SUMMARY

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MONITORING WELL (DATE SAMPLED)		ANALYSIS				
		TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS				
		TRICHLOROETHYLENE	TETRACHLOROETHYLENE	1,1,2,2-TETRACHLOROETHANE	ETHYLBENZENE	XYLENES
MW-603A	10/27/87	31	61*	23	–	–
	1/5/88	32*	57	24*	–	–
MW-603B	10/27/87	7.8	12	12	–	–
	1/5/88	6	11	9	–	–
MW-603C/DUP	10/27/87	–/–	J/J	J/J	–/–	–/–
	1/5/88	–/–	J/–	J/–	–/–	–/–
IRP-9/DUP	10/27/87	–/–	–/J	–/–	–/–	–/J
	1/5/88	–/–	–/–	–/–	–/–	J/–
MW-603E	10/27/87	–	–	–	–	–
	1/5/88	–	–	–	J	7*
RANGE		ND-32	ND-61	ND-24	–	ND-7
MCLs		5	5	–	700	10,000

Notes:

ND = Non-Detect
All values reported in micrograms per liter (µg/L)
* = Highest Detection
J = Concentration less than Contract Required Detection Limit
– = Not detected
MCL = Maximum Contaminant Level

Source: E.C. Jordan Co., 1989a

TABLE 6-5
MW-603 STUDY GROUNDWATER ANALYTICAL DATA SUMMARY

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MONITORING WELL	ANALYSIS				
	TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS			TARGET ANALYTE LIST INORGANICS	
	TRICHLOROETHYLENE	TETRACHLOROETHYLENE	1,1,2,2-TETRACHLOROETHANE	SODIUM	CALCIUM
MW-1201A	-	-	-	-	-
MW-1201B	-	-	-	-	-
MW-1202A	24	62*	-	-	-
MW-1202B	5	18	4	-	-
MW-1203A	-	-	-	-	-
MW-1204A/DUP	3/1	13/6	-	11,500*/10,800	-
MW-1204B	-	-	-	-	-
MW-1205B	-	-	-	-	-
MW-1205C	2	2	-	-	-
MW-1205D/DUP	14/13	14/13	5/5	9,270/8,480	5,240*/5,220
MW-1206Z	-	-	-	-	-
MW-1206A	1	2	-	-	-
MW-1206B	-	-	-	-	-
MW-1206C	-	-	-	-	-
MW-1207A	-	-	-	-	-
MW-1208A	2	3	1	-	-
MW-1209A	-	-	-	-	-
MW-1210A	-	-	-	-	-
MW-1212A	-	-	-	-	-
MW-1212B	-	-	-	-	-
MW-603Z	-	-	-	-	-
MW-603A/DUP	30*/14	53D/31	15*/7	9,090	-
MW-603B	5	13	10	-	-
RANGE	ND-30	ND-62	ND-15	ND-11,500	ND-5,240

Notes:

All values reported in micrograms per liter (µg/L)
* Highest Detection of Analyte
- = Not Detected
ND = Non-Detect

Source: E.C. Jordan Co., 1990c

The CS-4 groundwater operable unit will continue to migrate downgradient from its 1989 position at a rate of approximately 370 feet per year (ft/yr). This flow rate is equivalent to approximately 50 gallons per minute (gpm) across the 800-by-40-foot cross-sectional area of the plume. The 790 million gallons of water in the plume would require an estimated 30 years (based on the base plume flux) to pass the current location of the downgradient plume edge.

7.0 SUMMARY OF SITE RISKS

A human health risk assessment was conducted to estimate the probability and magnitude of potential adverse human health effects from exposure to contaminants associated with AOC CS-4. Environmental risk does not currently exist from contaminants in groundwater from AOC CS-4. Environmental risks would only be possible if the contaminated groundwater were allowed to migrate farther south and discharge into Coonamessett Pond. Because groundwater will be remediated before it reaches the pond, there would be no impact by AOC CS-4 groundwater to that surface water body. An ecological risk assessment was not conducted for AOC CS-4. However, once the extent of the AOC CS-10 plume has been characterized, an ecological risk assessment could be conducted for both groundwater plumes. The groundwater risk assessment is described in detail in the FFS (ABB Environmental Services, Inc., 1992a). The human health risk assessment followed a four-step process:

1. Contaminant identification, which identified those hazardous substances that, given the specifics of the site, were of significant concern.

2. Exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure.

3. Toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances.

4. Risk characterization, which integrated the three earlier steps to summarize the potential and actual carcinogenic and noncarcinogenic risks posed by hazardous substances at the site.

Results of the human health risk assessment for the AOC CS-4 are discussed in the following paragraphs, followed by the conclusions of the environmental risk assessment.

Four contaminants of concern were selected for evaluation in the risk assessment. All compounds detected at least once in the groundwater, except for 2-butanone, were retained as contaminants of concern, and are listed in Table 7-1. 2-Butanone was not selected as a contaminant of concern because it was present in laboratory blank samples and is not considered to be site-related. The health effects of each contaminant of concern are summarized in Appendix B of the FFS (ABB Environmental Services, Inc., 1992a).

Potential human health effects associated with exposure to the contaminants of concern were estimated quantitatively through the development of hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to hazardous substances based on the current and potential future uses and location of AOC CS-4. The following is a brief summary of the exposure pathways evaluated; a more thorough description is in the FFS (ABB Environmental Services, Inc., 1992a). The receptor population exposure pathway was assumed to be future downgradient residents. A lifetime (i.e., 70 years) of consuming 2 liters of groundwater per day for 350 days per year was assumed for an average body weight of 70 kilograms. It was assumed that the same size person would inhale volatilized contaminants at a rate of 0.6 cubic meter per hour during daily 12-minute showers. For each pathway evaluated, an average and a reasonable maximum exposure estimate was generated corresponding to exposure to the average and the maximum concentration detected in that particular medium.

Excess lifetime cancer risks were determined for each exposure pathway by multiplying the exposure level with the chemical-specific cancer potency factor. Cancer potency factors have been developed by USEPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is very unlikely to be greater than the predicted risk. The resulting risk estimates are expressed in scientific notation as a probability (e.g., $1x10^{-6}$ for 1/1,000,000) and indicate (using this example), that an individual is not likely to have greater than a one-in-a-million chance of developing cancer over 70 years as a result of site-related exposure as defined to the compound at the stated concentration. Current USEPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

The Hazard Index (HI) was also calculated for each pathway as USEPA's measure of the potential for noncarcinogenic health effects. The HI is calculated by dividing

TABLE 7-1
CONTAMINANT CONCENTRATIONS DETECTED IN GROUNDWATER

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL LEVEL	CONCENTRATION[1] RANGE	MEAN[2]	FREQUENCY[3] OF DETECTION	MAXIMUM DETECTED CONCENTRATION
Volatile Organic Compounds (µg/L)				
Tetrachloroethylene	ND-62	18	14/20	62
Trichloroethylene	ND-32	9.1	14/20	32
1,1,2,2-Tetrachloroethane	ND-24	6.8	11/20	24
1,2-Dichloroethylene (total)[4]	ND-21	1.1	1/20	26

Notes:

[1] Duplicate samples were averaged.
[2] Arithmetic means were calculated using one-half the Contract Required Quantitation Limit.
[3] The frequency of detection is the number of samples in which a compound is detected over the number of samples available.
[4] 1,2-Dichloroethylene was selected for evaluation due to its potential to migrate downgradient of the source.

ND = Non-Detect
µg/L = micrograms per liter

the exposure level by the reference dose (RfD) or other suitable benchmark for noncarcinogenic health effects. RfDs have been developed by USEPA to protect sensitive individuals over the course of a lifetime and they reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. The HI is often expressed as a single value (e.g., 0.3) indicating the ratio of the stated exposure as defined to the RfD value (in this example, the exposure is approximately one-third of an acceptable exposure level for the given compound). The HI is only considered additive for compounds that have the same or similar toxic endpoints (for example: the HI for a compound known to produce liver damage should not be added to a second whose toxic endpoint is kidney damage).

Table 7-2 depicts the carcinogenic and noncarcinogenic risk summary for contaminated groundwater ingestion and inhalation of volatilized contaminants in the shower. More detailed tables of the risk assessment are in Appendix B of the AOC CS-4 FFS (ABB Environmental Services, Inc., 1992a).

Carcinogenic risks are compared to the USEPA target carcinogenic risk range of 10^{-4} to 10^{-6}. Noncarcinogenic risks are compared to the USEPA target noncarcinogenic HI of 1.0 (USEPA, 1990).

Future potential carcinogenic risks for downgradient residents ingesting and inhaling groundwater contaminants were estimated to be $3x10^{-5}$ (average case) and $1x10^{-4}$ (reasonable worst case). Noncarcinogenic risks were estimated to be 0.02 (average case) and 0.08 (reasonable worst case). Both carcinogenic and noncarcinogenic risks fall within the USEPA target risk ranges.

Federal MCLs represent the maximum contaminant concentration allowable in public water supplies. Both the mean and maximum concentrations of TCE and PCE exceed their respective MCLs (Table 7-3). The detected concentration of 1,2-DCE (total) is less than the MCL for the cis-isomer. There is no MCL for 1,1,2,2-tetrachloroethane.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent

TABLE 7-2
SUMMARY OF RISKS RESULTING FROM EXPOSURE TO GROUNDWATER CONTAMINANTS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

EXPOSURE LOCATION	EXPOSURE MEDIUM	EXPOSURE ROUTE	LIFETIME INCREMENTAL CARCINOGENIC RISK	NONCARCINOGENIC HAZARD INDEX
			AVERAGE	
AOC CS-4	Groundwater	Ingestion	$3x10^{-5}$	0.02
		Inhalation of Volatilized Contaminants	$3x10^{-6}$	NA
		TOTAL	$3x10^{-5}$	0.02
			MAXIMUM	
AOC CS-4	Groundwater	Ingestion	$9x10^{-5}$	0.08
		Inhalation of Volatilized Contaminants	$1x10^{-5}$	NA
		TOTAL	$1x10^{-4}$	0.08

Note:

NA = Appropriate toxicity information is not available to evaluate this route of exposure.

TABLE 7-3
CONTAMINANT CONCENTRATIONS AND FEDERAL MAXIMUM CONTAMINANT LEVELS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

CHEMICAL	MEAN CONCENTRATION (µg/L)	MAXIMUM CONCENTRATION (µg/L)	FEDERAL MCL (µg/L)
Tetrachloroethylene	18	62	5
Trichloroethylene	9.1	32	5
1,1,2,2-Trichloroethane	6.8	24	NA
1,2-Dichloroethylene (total)	1.1	26	70[1]

Notes:

NA = Not Available
[1] = MCL is for the cis-isomer
µg/L = micrograms per liter

and substantial endangerment to human health, welfare, or the environment. Risks due to groundwater releases are dealt with in this ROD.

8.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Four alternatives were developed and screened in the FFS. This section describes the response objectives and the development and screening of alternatives.

8.1 STATUTORY REQUIREMENTS/RESPONSE OBJECTIVES

Under its legal authorities, NGB's primary responsibility at this NPL site is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including a requirement that the remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria, or limitations, unless a waiver is invoked; a requirement that the selected remedial action is cost-effective and utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment that permanently and significantly reduces the mobility, toxicity, or volume of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed to be consistent with these Congressional mandates.

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial action objectives were developed to aid in the development and screening of alternatives. These interim remedial action objectives were developed to mitigate existing and future potential threats to human health and the environment:

- Reduce the potential risk associated with ingestion of contaminated groundwater to acceptable levels.
- Protect uncontaminated groundwater and surface water for future use by minimizing the migration of contaminants.
- Reduce the time required for aquifer restoration.

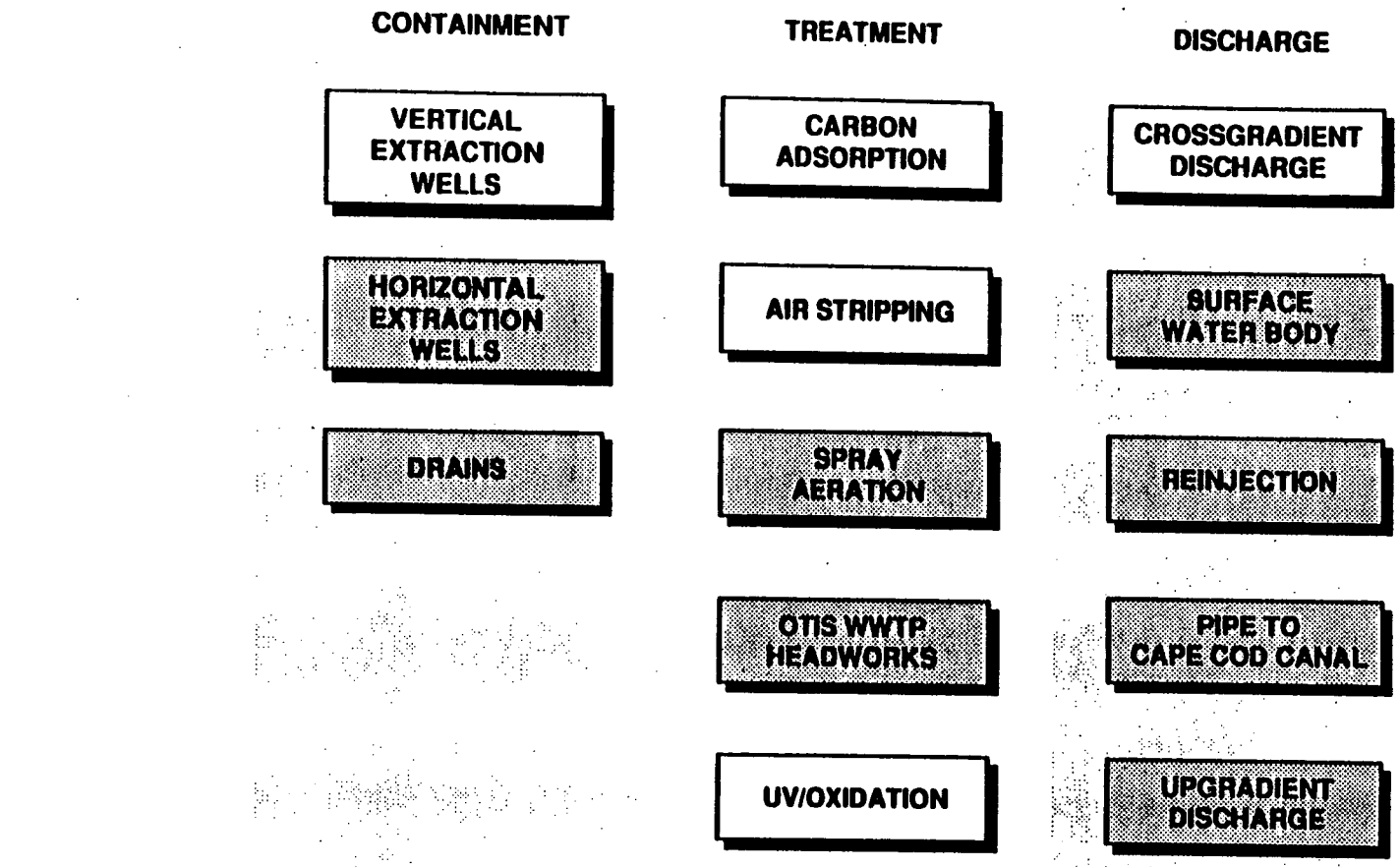
8.2 ALTERNATIVES DEVELOPMENT AND SCREENING

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives was developed for AOC CS-4 groundwater plume containment.

With respect to the groundwater response action, the FFS developed a no action alternative and a limited number of interim remedial alternatives that attain site-specific remediation levels using different technologies (ABB Environmental Services, Inc., 1992a).

Section 5.0 of the FFS identified, assessed, and screened technologies based on implementability, effectiveness, and cost. The FFS focused only on groundwater contaminant migration technologies. A separate report addresses source control technologies (ABB Environmental Services, Inc., 1991). Section 6.0 of the FFS presented the interim remedial alternatives developed by combining the technologies identified in the initial screening process per Section 300.430(e)(3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated and screened in Section 7.0 of the FFS.

Of the 13 remedial technologies screened in the FFS, five were retained for detailed analysis. Figure 8-1 identifies the five technologies retained through the screening process, as well as those eliminated from further consideration.



LEGEND

Technology Eliminated from Further Consideration

ABB Environmental Services, Inc. (ASEA BROWN BOVERI)	SCREENING OF REMEDIAL TECHNOLOGIES	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	AOC CS-4 ROD	FIGURE 8-1

9201043D

9.0 DESCRIPTION OF ALTERNATIVES

This section provides a narrative summary of each alternative evaluated. A detailed tabular assessment of each alternative is in Table 8-1 of the FFS (ABB Environmental Services, Inc., 1992a).

No source control alternatives were studied in the AOC CS-4 groundwater FFS. Details of the source area removal action are discussed in the AOCs CS-4, FS-25, and FTA-1 source EE/CA (ABB Environmental Services, Inc., 1991).

9.1 CONTAINMENT ALTERNATIVES ANALYZED

Containment alternatives address contaminants that have migrated from the original source of contamination. At AOC CS-4, contaminants have migrated in a south-southwesterly direction from the AOC CS-4 site at an estimated rate of 370 ft/yr. The alternatives evaluated for AOC CS-4 are a minimal no-action alternative (GW-1); a vertical extraction system, activated carbon treatment, and discharge alternative (GW-2); a vertical extraction system, air-stripping treatment, and discharge alternative (GW-3); and a vertical extraction system, ultraviolet (UV)/oxidation treatment, and discharge alternative (GW-4).

9.1.1 Alternative GW-1: Minimal No Action

The minimal no-action alternative provides a baseline against which other alternatives can be compared. This alternative does not involve remedial actions to treat contaminated groundwater. The contaminant plume would not be removed from the aquifer. The minimal no-action alternative would include sampling of existing monitoring wells, and some of the observation wells proposed to be installed for the alternatives involving extraction. Review of the site would also be conducted every five years. The minimal no-action alternative would not reduce risk and would not meet the response objectives described in Subsection 8.1.

Estimated Time for Design and Construction: 6 Months

Estimated Time of Operation: 5 Years

Estimated Capital Cost: None

Estimated Operations and Maintenance Costs (net present worth):* $236,000 to $506,000

Estimated Total Cost (net present worth):* $236,000 to $506,000

*Net present worth costs are based on a 10 percent discount factor and five years of operation.

9.1.2 Alternative GW-2: Extraction, Carbon Adsorption Treatment, and Discharge

The extraction, carbon adsorption treatment, and discharge alternative consists of the environmental monitoring program described for the minimal no-action alternative and a groundwater containment and treatment system. The components of this alternative are as follows:

- groundwater extraction wells
- activated carbon treatment
- discharge of treated water
- environmental monitoring well sampling
- hydraulic performance monitoring

To facilitate containment of contaminated groundwater, an extraction well system would be installed. The volume of AOC CS-4 groundwater is estimated to be approximately 790 million gallons, assuming an aquifer porosity of 30 percent. The area of containment is shown in Figure 6-3. Using data from the AOC CS-4 pumping test, it is estimated that 13 extraction wells yielding approximately 115 gpm total could be installed at the toe of the plume to contain AOC CS-4 groundwater. In addition, observation wells would be installed to evaluate the effectiveness of the extraction system. The exact number and location of wells would be determined during remedial design.

After extraction, carbon adsorption would remove the VOCs found in AOC CS-4 groundwater. Activated carbon, a highly porous substance, selectively adsorbs contaminants by a surface attraction phenomenon in which organic molecules are attracted to the internal pores of the carbon granules. Once the micropore surfaces

are saturated with organics, the carbon is considered spent and must be replaced with virgin carbon, or removed, thermally regenerated, and replaced. Contaminants are permanently destroyed during the regeneration process. The time for the carbon to be considered spent will be assessed by monitoring influent and effluent chemical concentrations.

Treated groundwater would be pumped from the treatment plant to infiltration trenches located crossgradient from the plume, where the water would be allowed to infiltrate below grade and return to the aquifer from which it was removed. The infiltration area would be prepared with sand, gravel, and other materials. Water would be distributed by perforated pipes over the trench area.

Chemical sampling of existing monitoring wells and some of the proposed observation wells would monitor the plume's flowpath and chemical concentrations. Sampling proposed monitoring wells upgradient of the infiltration area will assess groundwater contaminant levels upgradient of the discharge area. The proposed monitoring program is described in the AOC CS-4 groundwater FFS and outlined in Section 5.0 of this ROD (ABB Environmental Services, Inc., 1992a). As an interim remedy, this alternative would provide an increased level of protection to downgradient receptors, compared to baseline conditions. The extraction and treatment system would contain the AOC CS-4 groundwater plume and treat this water to the appropriate discharge requirements (i.e., MCL concentrations). This alternative is expected to provide a permanent reduction in contaminant concentrations in groundwater.

Estimated Time for Design and Construction: 1 Year

Estimated Time of Operation: 5 Years

Estimated Capital Cost: $1,641,000 to $3,516,000

*Estimated Operations and Maintenance Costs (net present worth):** $472,000 to $1,012,000

*Estimated Total Cost (net present worth):** $2,113,000 to $4,528,000

*Net present worth costs are based on a 10 percent discount factor and five years of operation.

9.1.3 Alternative GW-3: Extraction, Air-stripping Treatment, and Discharge

The extraction, air-stripping treatment, and discharge alternative would be similar to the GW-2 alternative, except that VOCs would be removed by air stripping, followed by vapor-phase carbon adsorption. Extraction of groundwater, discharge of treated groundwater, environmental and hydraulic monitoring, and a five-year review would be identical to the GW-2 alternative.

Air stripping removes relatively volatile components from groundwater by passing air through the contaminated water. To accomplish this, groundwater is pumped to the top of an air-stripping tower and allowed to flow down through packing materials to the bottom. At the same time, air is blown upward through the tower and packing materials. Volatile contaminants transfer from water to air. The air is then treated using activated carbon in a manner similar to the preferred alternative. The vapor-phase carbon would be reactivated off-site so that it could be used again at a later date.

As an interim remedy, this alternative would provide an increased level of protection to downgradient receptors, compared to baseline conditions. The extraction and treatment system would contain the AOC CS-4 groundwater plume and treat this water to the appropriate discharge requirements (i.e., MCL concentrations). This alternative is expected to provide a permanent reduction in contaminant concentrations in groundwater.

Estimated Time for Design and Construction: 1 Year

Estimated Time of Operation: 5 Years

Estimated Capital Cost: $1,832,000 to $3,925,000

Estimated Operations and Maintenance Costs (net present worth):* $698,000 to $1,496,000

Estimated Total Cost (net present worth):* $2,530,000 to $5,421,000

*Net present worth costs are based on a 10 percent discount factor and five years of operation.

9.1.4 Alternative GW-4: Extraction, Ultraviolet/Oxidation Treatment, and Discharge

The extraction, UV/oxidation treatment, and discharge alternative would be similar to the GW-2 alternative, except that VOCs would be removed by UV/oxidation treatment in place of carbon adsorption. Extraction of groundwater, discharge of treated groundwater, environmental and hydraulic monitoring, and a five-year review would be identical to the GW-2 alternative.

In place of the carbon adsorption unit described in the GW-2 alternative, a UV/oxidation reactor would be used. The UV/oxidation technology destroys organic compounds in wastewater and groundwater through chemical oxidation enhanced by exposure to the UV light. UV/oxidation occurs in a stainless steel chamber containing vertically or horizontally mounted UV lamps. An oxidant is added to the water in the tank, which breaks down contaminants into less harmful chemicals. The UV light enhances the oxidant's ability to break down contaminants. The oxidant proposed for this alternative is hydrogen peroxide.

As an interim remedy, this alternative would provide an increased level of protection to downgradient receptors, compared to baseline conditions. The extraction and treatment system would contain the AOC CS-4 groundwater plume and treat this water to the appropriate discharge requirements (i.e., MCL concentrations). This alternative is expected to provide a permanent reduction in contaminant concentrations in groundwater.

Estimated Time for Design and Construction: 1 Year

Estimated Time of Operation: 5 Years

Estimated Capital Cost: $2,443,000 to $5,234,000

Estimated Operations and Maintenance Costs (net present worth):* $584,000 to $1,251,000

Estimated Total Cost (net present worth):* $3,027,000 to $6,485,000

*Net present worth costs are based on a 10 percent discount factor and five years of operation.

9.2 SOURCE CONTROL ALTERNATIVES ANALYZED

No source control alternatives were evaluated as part of this ROD. AOC CS-4 soils are being addressed separately as part of a removal action for three sites (ABB Environmental Services, Inc., 1991). This separation of the source area soils and the downgradient groundwater is consistent with the operable unit approach outlined in the NCP. If implemented in conjunction with the source control remediation, these groundwater alternatives would provide a sitewide response plan for AOC CS-4.

10.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that, at a minimum, NGB is required to consider in its assessment of alternatives. Building on these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on the alternatives using the nine evaluation criteria to select an interim site remedy. The following summary compares each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria and their definitions are discussed in the following subsections.

10.1 THRESHOLD CRITERIA

The following two threshold criteria described must be met for alternatives to be eligible for selection in accordance with the NCP:

- **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- **Compliance with ARARS** addresses whether a remedy will meet all of the ARARs of other federal and state environmental laws and/or provide grounds for invoking a waiver.

10.2 PRIMARY BALANCING CRITERIA

The following five criteria are used to compare and evaluate the alternatives that meet the threshold criteria:

- **Long-term Effectiveness and Permanence** assesses alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

- **Reduction of Mobility, Toxicity, or Volume Through Treatment** addresses the degree to which alternatives employ recycling or treatment that reduces mobility, toxicity, or volume, including how treatment is used to address the principal threats posed by the site.

- **Short-term Effectiveness** addresses the time needed to achieve protection and any adverse impacts on human health and the environment.

- **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- **Cost** addresses the estimated capital and operations and maintenance costs on a present-worth basis.

10.3 MODIFYING CRITERIA

The modifying criteria are used on the final evaluation of remedial alternatives generally after NGB has received public comment on the FFS and Proposed Plan:

- **State Acceptance** addresses the Commonwealth's position and key concerns related to the preferred alternative and other alternatives including comments on ARARs or the proposed use of waivers.

- **Community Acceptance** addresses the public's general response to the alternatives described in the FFS and Proposed Plan reports.

Following the detailed analysis of each alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. The comparative analysis is presented in the FFS (ABB Environmental Services, Inc., 1992a).

The following subsection presents the nine criteria and a brief narrative summary of the alternatives and their strengths and weaknesses according to the detailed and comparative analysis.

10.4 Overall Protection of Human Health and the Environment

All the remedial alternatives, except the minimal no-action alternative, would provide an increased level of protection to human receptors. The minimal no-action alternative was not designed to achieve remedial action objectives. Alternatives GW-2, GW-3, and GW-4 include containment, treatment, and discharge components that would effectively reduce contaminant concentrations in groundwater. Protection is provided by containment of the plume to prevent the migration of contaminated groundwater to currently uncontaminated areas.

10.5 Compliance with ARARs

The minimal no-action alternative was not designed to achieve remedial action objectives and, therefore, would not comply with chemical-specific ARARs. Groundwater treatment, carbon adsorption, or UV/oxidation is expected to remove VOCs.

The design of the AOC CS-4 groundwater containment option would be based on compliance with location- and action-specific ARARs. The final treatment standards for groundwater would be based on achieving discharge requirements. In addition, all work conducted at AOC CS-4 would be in accordance with Occupational Safety and Health Administration (OSHA) requirements.

10.6 Long-Term Effectiveness and Permanence

The minimal no-action alternative would not meet remedial action objectives. AOC CS-4 groundwater would continue to pose a risk to human health until natural attenuation reduced contaminant levels in the groundwater. Environmental monitoring and site reviews would evaluate the effectiveness of natural attenuation

in reducing contaminant concentrations; future remedial actions may be recommended.

The other three groundwater treatment alternatives (i.e., Alternatives GW-2, GW-3, and GW-4) would meet remedial action objectives for groundwater because the water would be collected and treated before it could migrate farther downgradient. Each treatment option is considered to provide a permanent remedy for removal of contaminants in AOC CS-4 groundwater. Future long-term remedial actions will be evaluated once AOC CS-10 groundwater has been sufficiently characterized.

10.7 Reduction of Mobility, Toxicity, or Volume

This criterion is relevant only for treatment alternatives. The minimal no-action alternative does not reduce the mobility, toxicity, or volume of contaminants or contaminated media. All three of the water treatment alternatives would reduce the mobility, toxicity, and volume of contaminants in groundwater. The reductions for each treatment alternative are evaluated in the FFS (ABB Environmental Services, Inc., 1992a).

10.8 Short-Term Effectiveness

Implementing the minimal no-action alternative would not result in additional adverse impacts on human health or the environment than already exist from AOC CS-4 groundwater. For the other alternatives, impacts on human health would result from increased drilling equipment and construction materials transported to the site.

Impacts on the environment during remedial activities include the removal of trees during site preparation before installing the extraction system, treatment units, and discharge area. However, these components would be designed to have minimal impact on the environment.

Impacts to workers implementing remedial actions as part of Alternative GW-2, GW-3, and GW-4 would be mitigated by the use of appropriate personal protective equipment and clothing and by following safe work practices, as outlined in a Health and Safety Plan. These impacts would be minimal to workers implementing the

environmental monitoring programs as part of Alternative GW-1 because no invasive work would be required.

10.9 IMPLEMENTABILITY

All the remedial alternatives are implementable, although obtaining access to the Crane Wildlife Refuge Area to conduct monitoring or remedial actions would require coordination with personnel responsible for MMR security. Each technology described is well developed and widely available, and has been successfully demonstrated at other Superfund sites. If it is determined that additional remedial actions are necessary in the future, the AOC CS-4 groundwater treatment system may require modification or replacement.

10.10 COST

The alternative cost estimates are a combination of costs estimated for each component. Each remedial alternative includes the cost of the institutional controls and environmental monitoring program given for Alternative GW-1, minimal no action.

The least expensive alternative is the minimal no-action alternative, estimated to cost up to $506,000. For Alternative GW-2, GW-3, and GW-4, the costs of the three different types of treatment processes were compared. The total costs of the three groundwater containment and treatment alternatives are similar and are discussed in Section 9.0 of this ROD.

10.11 STATE ACCEPTANCE

The Commonwealth of Massachusetts has indicated its concurrence with the selected remedy; this concurrence letter is presented in Appendix B.

10.12 COMMUNITY ACCEPTANCE

Based on the written and oral comments received during the recent comment period, there is general acceptance of the selected remedy, although some people commenting requested more information. Responses to community comments are in Appendix E.

11.0 THE SELECTED INTERIM REMEDY

The NGB has chosen Alternative GW-2 as the selected alternative. Alternative GW-2 is an interim remedy, the goals of which are to manage the migration of contaminants, treat the contaminated groundwater to reach the discharge limits, and discharge treated groundwater crossgradient from the groundwater plume, while the AOC CS-10 plume is characterized and final remedial alternatives are studied.

11.1 CLEAN-UP LEVELS

Clean-up levels have been established for the contaminants of concern identified in the risk assessment that are found to pose an unacceptable risk to either human health or the environment. Clean-up levels have been set based on the appropriate ARARs (e.g., drinking water MCLs and MCLGs, if available). In the absence of a chemical-specific ARAR, or other suitable criteria to be considered, a 10^{-5} excess cancer risk level for carcinogenic effects or a concentration corresponding to an HI of 1.0 for compounds with noncarcinogenic effects was used to set clean-up levels. In instances in which the values described were not feasible to quantify, the Practical Quantitation Limit was used as the clean-up level. Periodic assessments of the protection afforded by the remedial action will be made as the interim remedy is implemented. If the interim remedial action is not found to be protective, further action will be required while the final remedy is developed.

Because the aquifer at the compliance boundary of AOC CS-4 is a Class I aquifer, MCLs and non-zero MCLGs established under the Safe Drinking Water Act (SDWA) are ARARs.

Clean-up levels for known and probable carcinogenic compounds have been set at the appropriate MCL. In the absence of an MCL, a proposed drinking water standard, or other suitable criteria (i.e., health advisory or state standard), a clean-up level was derived for carcinogenic effects based on a 10^{-5} excess cancer risk level for groundwater ingestion.

Table 11-1 summarizes the clean-up levels for the VOCs of concern identified in groundwater. The clean-up levels must be met at the completion of the final

TABLE 11-1
PROPOSED TREATMENT LEVELS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

CARCINOGEN CONTAMINANTS OF CONCERN	TREATMENT LEVEL	BASIS	LEVEL OF RISK	
			INGESTION	INHALATION
Tetrachloroethylene	5 µg/L	MCL	$3x10^{-6}$	$1x10^{-6}$
Trichloroethylene	5 µg/L	MCL	$7x10^{-7}$	$3x10^{-7}$
1,1,2,2-Tetrachloroethane	2 µg/L	*	$1x10^{-5}$	$9x10^{-6}$
		SUM	$2x10^{-5}$	$1x10^{-5}$

NON-CARCINOGEN CONTAMINANTS OF CONCERN	TREATMENT LEVEL	BASIS	HAZARD INDEX	
			INGESTION	INHALATION
1,2-Dichloroethylene	70 µg/L	MCL	$1x10^{-1}$	–
Tetrachloroethylene	5 µg/L	MCL	$1x10^{-2}$	–
Trichloroethylene	5 µg/L	MCL	–	–
1,1,2,2-Tetrachloroethane	2 µg/L	*	–	–
		SUM	$1x10^{-1}$	–

Notes:

* The 1,1,2,2-tetrachloroethane detected in groundwater does not have Federal MCLs, MCLGs, or Massachusetts MCLs, MCLGs; therefore, a risk-based treatment level was proposed. The risk-based treatment level was calculated assuming a $1x10^{-4}$ risk level and using the USEPA risk guidance for human health exposure scenarios.

Per USEPA Region I direction residual risks were calculated on the following assumptions:

ingestion rate:	2 liters/day
average body weight:	70 kg
frequency of exposure:	365 days/year
duration of exposure:	70 years
life expectancy:	70 years

These assumptions differ from the assumptions on USEPA 1991 OSWER Directive 9285.6-03 and those used in the baseline risk assessment.

µg/L = micrograms per liter
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
USEPA = U.S. Environmental Protection Agency

W003929.T80/9

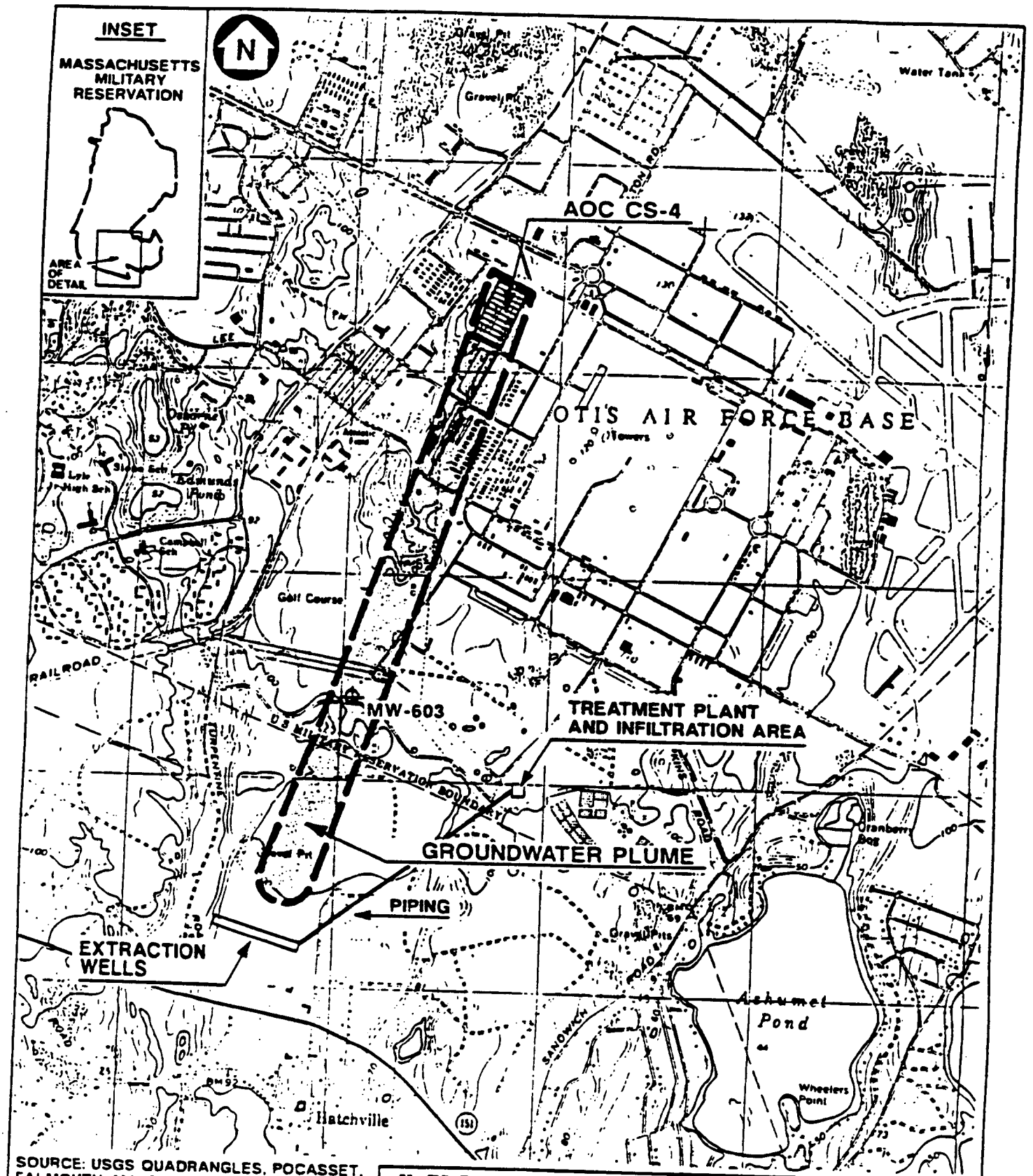
remedial action. The interim remedial action will operate for a minimum of five years. The NGB has estimated that the clean-up level will be attained within 30 years. The clean-up levels are consistent with ARARs for groundwater and attain USEPA's risk management goal for remedial actions.

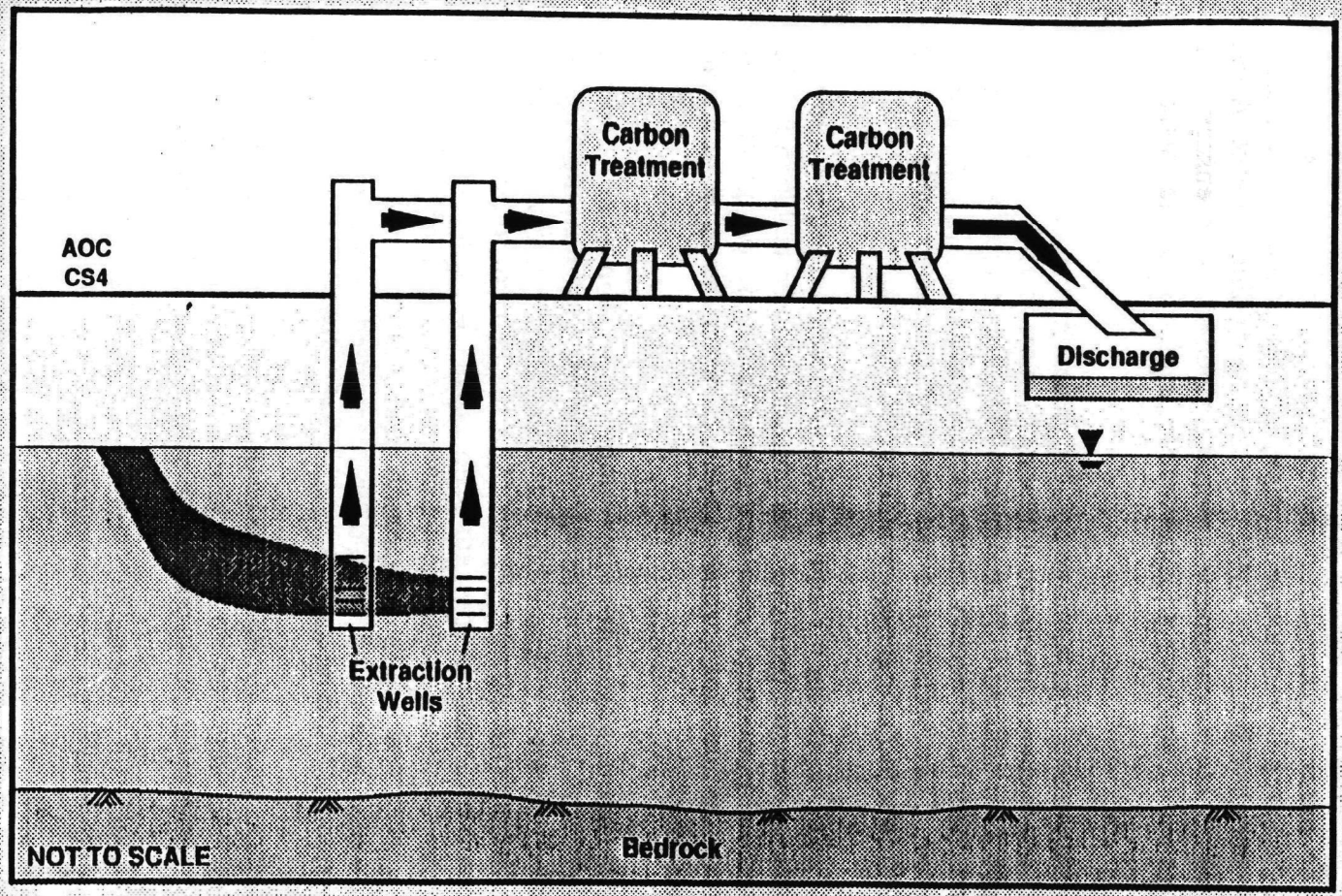
11.2 DESCRIPTION OF REMEDIAL COMPONENTS

The selected interim remedy, Alternative GW-2, to remediate contaminated groundwater consists of groundwater extraction wells at the leading edge of the AOC CS-4 plume; treatment of the collected groundwater; and discharge of the treated groundwater onto MMR property. Figures 11-1 and 11-2 show the approximate locations of the groundwater extraction wells, piping to the treatment plant, and approximate locations of the treatment plant and treated groundwater infiltration trenches. The selected alternative is expected to operate for a minimum of five years, during which time monitoring and characterization of the CS-10 groundwater plume will be performed. A final remedy will be determined to address the CS-10 and CS-4 groundwater plumes.

Groundwater extraction would be accomplished using a network of approximately 13 vertical extraction wells positioned across the width of the plume and the depth of contamination. The extraction wells would be equidistant from one another, located 60 feet apart, and pumped to provide a combined flow rate of 115 gpm. Observation wells downgradient and to the sides of the extraction wells would be installed to evaluate hydraulic effectiveness of the extraction system.

Pumping extraction wells is effective in containing plumes in groundwater because pumping draws down the local groundwater table, inducing gradients that cause the groundwater to flow toward the well instead of the normal flow direction. Positioning the extraction wells at the toe of the plume would prevent the plume from moving farther downgradient. Extraction wells are simple to install. Wells and pumps can be sized to handle a wide range of flow rates. Locating well screens within the plume would increase the effectiveness of capture. Potential drawbacks of this technology are installation of the wells in the Crane Wildlife Refuge Area and potential for influencing the flowpath of the AOC CS-10 groundwater plume, which has not been fully characterized to date.


INSET
MASSACHUSETTS MILITARY RESERVATION
AREA OF DETAIL
N
AOC CS-4
OTIS AIR FORCE BASE
MW-603
TREATMENT PLANT AND INFILTRATION AREA
GROUNDWATER PLUME
PIPING
EXTRACTION WELLS
Golf Course
RAILROAD
Ashumet Pond
Hatchville
Wheelers Point
Cranberry Bog
SOURCE: USGS QUADRANGLES, POCASSET, FALMOUTH, MA. PHOTOREVISED 1979.
NOTE: PLUME BOUNDARY IS DELINEATED BASED ON 1989 GROUNDWATER DATA.
SCALE IN FEET
0
2,000
4,000
ABB Environmental Services, Inc.
ASEA BROWN BOVERI
PREFERRED ALTERNATIVE LAYOUT
INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION
AOC CS-4 ROD
FIGURE 11-1
7030-02



LEGEND

- GROUND SURFACE
- WATER TABLE
- CONTAMINANT PLUME

ABB Environmental Services Inc.
ASEA BROWN BOVERI

GROUNDWATER EXTRACTION AND CARBON TREATMENT SYSTEM

INSTALLATION RESTORATION PROGRAM
MASSACHUSETTS MILITARY RESERVATION

AOC CS-4 ROD

FIGURE 11-2

The effect of AOC CS-4 extraction on the AOC CS-10 groundwater plume cannot be evaluated until the aquifer is actually pumped; therefore, this interim remedial action would need to be carefully monitored during implementation. Coordination would be required among officials at MMR, the Crane Wildlife Refuge Area, construction contractors, and environmental monitoring personnel to ensure that access can be obtained for both long- and short-term activities associated with the interim remedy.

If iron and manganese were in the groundwater at high enough concentrations, they would interfere with the organic groundwater treatment system (carbon adsorption). Groundwater samples were collected in December 1991 from two monitoring wells. One well was located near the expected location of the extraction wells; the other in the middle of the plume. The samples had low iron and manganese concentrations; therefore, removal of iron and manganese would not be required.

An on-site activated carbon adsorption treatment system would effectively remove organic materials from water by sorption (i.e., the attraction and accumulation of one substance on the surface of another). As water passes through porous granules of carbons, contaminant molecules are attracted to the surface of the pores and held there by weak physical forces.

As activated carbon adsorbs molecules from water, the carbon pores become saturated with contaminants. An activated carbon adsorption system would require units to be connected in series. Figure 11-3 is a schematic of a typical carbon adsorption system. Regular sampling of effluent from the first carbon bed in the series would be required to assess the breakthrough point. Breakthrough occurs when the concentration of the target pollutant in the effluent is higher than the desired level. Once the carbon has been spent, a new charge of carbon would replace the spent carbon. Spent carbon would be reactivated off-site to be used again on-site at a later date. Minimal carbon waste is generated.

Carbon treatment units are readily available and would be implementable for AOC CS-4 groundwater. If the contact time in the carbon units is sufficient, this process will remove up to 99 percent of the absorbable organics in AOC CS-4 groundwater.

Treated groundwater would be pumped from the treatment plant to infiltration trenches located crossgradient from the plume, where the water would be allowed

TWO-VESSEL GRANULAR CARBON ADSORPTION SYSTEM

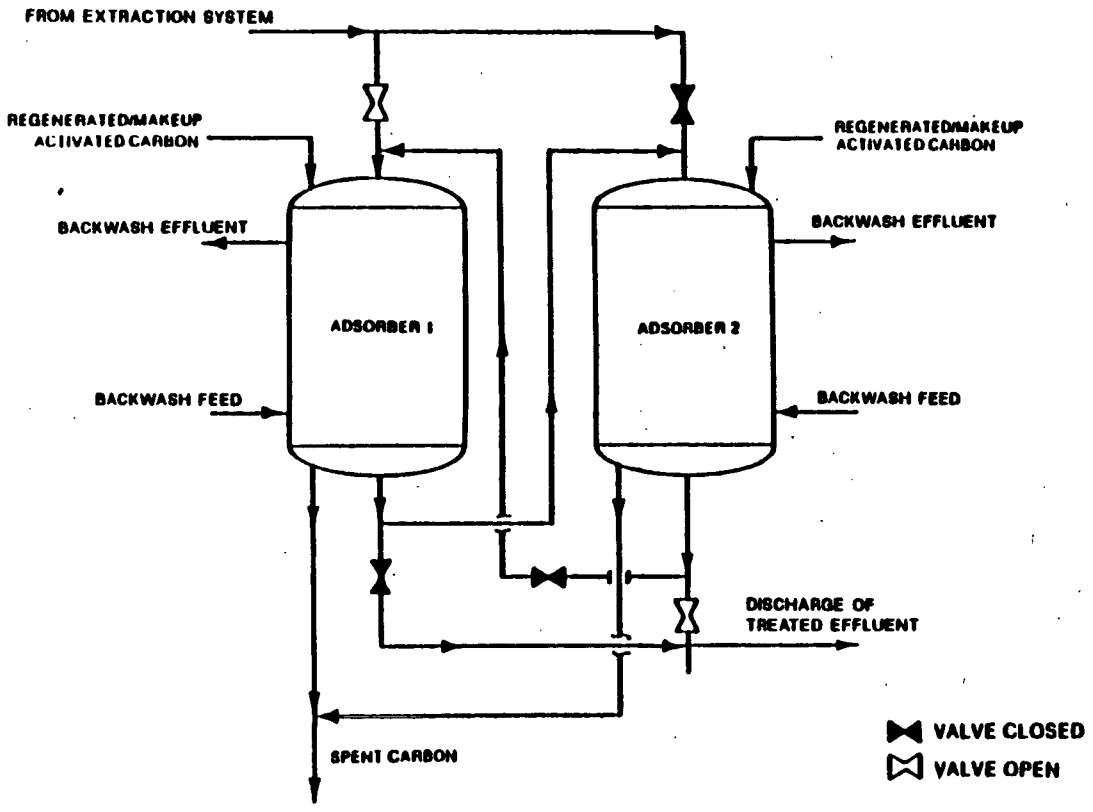


ABB Environmental Services, Inc.	TWO-VESSEL GRANULAR CARBON ADSORPTION SYSTEM	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	AOC CS-4 ROD	FIGURE 11-3

SOURCE: USEPA, 1985.

to infiltrate below grade and return to the aquifer from which it was removed. The infiltration trenches would be prepared with perforated pipe, sand, gravel, and other materials. Water would be distributed by perforated pipes over the trench area.

The discharge area would be located to (1) not adversely influence the flowpath of other plumes along the southern boundary of MMR (i.e., the FTA-1 and Ashumet Valley plumes); (2) be in an area where no other plumes have been identified to date; and (3) be on MMR property. The proposed location of the crossgradient discharge is approximately 2,000 feet west of the Otis Wastewater Treatment Plant and 600 feet north of the MMR boundary. The area is shown in Figure 11-1.

The objective of the monitoring program would be to evaluate the effectiveness of the groundwater extraction wells to contain the groundwater contaminant plume, to determine the reduction in contaminant concentrations as the treatment progresses, and to determine groundwater quality upgradient of the discharge area. The environmental monitoring plan would involve sampling of groundwater. Samples would be analyzed for Target Compound List VOCs; some wells would be sampled for other compounds. Existing wells and some of the observation wells were proposed for sampling to provide information on contaminant movement attenuation and dispersion in groundwater. Monitoring wells are proposed to be installed upgradient of the infiltration area to monitor upgradient groundwater quality. These wells would provide information on levels of contaminants entering the extraction area and monitor groundwater quality and plume migration.

To the extent required by law, the NGB and USEPA will review the AOC CS-4 site at least once every five years after initiation of the remedial action until no hazardous substances, pollutants, or contaminants remain on the site. The review will ensure that the remedial action continues to protect human health and the environment. The NGB and USEPA will also evaluate the risk posed by AOC CS-4 at the completion of the final remedial action.

12.0 STATUTORY DETERMINATIONS

The interim remedial action selected for implementation at AOC CS-4 is consistent with CERCLA and, to the extent practicable, the NCP. The selected interim remedy protects human health and the environment, attains ARARs, and is cost-effective. The selected remedy, which is not designed or expected to be final, also satisfies the statutory preference for treatment that permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances. Additionally, the selected remedy uses alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

12.1 THE SELECTED INTERIM REMEDY IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The remedy at AOC CS-4 will permanently reduce the risks posed to human health by eliminating, reducing, or controlling exposures to human and environmental receptors through treatment, engineering controls, and institutional controls. More specifically, this remedy will provide an increased level of protection to downgradient receptors by containing the AOC CS-4 groundwater plume and treating the contaminated water to the appropriate discharge requirements. Moreover, the selected remedy will result in human exposure levels that are within the 10^{-4} to 10^{-6} incremental cancer risk range and that are within the HI of 1.0 for noncarcinogens. This remedy will result in treated discharge less than the MCLs.

Environmental risks do not currently exist from contaminants in the groundwater from AOC CS-4. Environmental risks would only be possible if the contaminated groundwater were allowed to migrate farther south and discharge into Coonamessett Pond. Because groundwater will be remediated before it reaches the pond, there would be no effect by AOC CS-4 groundwater on that surface water body.

Finally, implementing the selected interim remedy will not pose unacceptable short-term risks or cross-media impacts. Remedial construction activities are not likely to adversely affect the public or MMR personnel. Initial grading of the treatment system location and installation of groundwater monitoring and observation wells are not expected to encounter or expose contaminants. The greatest potential threat to

the public from construction-related activities would be due to fugitive dust created during site preparation. Ambient air monitoring for respirable dust would be conducted during remedial construction activities. Engineering controls for dust suppression are readily available and could be implemented easily if necessary.

12.2 THE SELECTED INTERIM REMEDY ATTAINS ARARS

This remedy will attain all applicable or relevant and appropriate federal and state requirements that apply to this limited scope interim action for AOC CS-4 groundwater. Generally, ARARs for the selected interim remedial action are a subset of those listed in Tables 4-1 through 4-3 of the FFS. The ARARs that do correspond to this interim action are listed in Tables 12-1 through 12-3. A narrative summary of significant ARARs is provided in the following subsections.

12.2.1 Location-specific ARARs

Location-specific ARARs for AOC CS-4 groundwater are identified in Table 12-1.

Sole-source Aquifer Regulations. In general, projects that would be subject to review under the sole-source aquifer program include highway or building construction projects, either of which could have potentially detrimental effects on human health and the surrounding environment. The proposed CERCLA activities would not increase current contaminant concentrations in the sole-source aquifer; the proposed interim remedial action would actually decrease the contaminant concentrations of AOC CS-4 groundwater and of the aquifer.

12.2.2 Chemical-specific ARARs

Chemical-specific ARARs are identified in Table 12-2 and are briefly discussed in the following paragraphs.

Groundwater Regulations. The SDWA drinking water standards were used, when available, to develop Target Clean-up Levels for AOC CS-4 groundwater. Massachusetts also has groundwater quality standards that limit the concentrations of certain material allowed in groundwater. The federal standards were relevant and

TABLE 12-1
LOCATION-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
SOLE-SOURCE AQUIFERS				
Federal	SDWA Sole-Source Aquifers (40 CFR 149)	Relevant and Appropriate	USEPA is authorized to designate aquifers as sole source and review federal financially assisted projects in the area to determine the project's potential to contaminate the aquifer. No federal assistance may be made for projects that may contaminate the aquifer. Conversely, federal funds may be used to modify projects to ensure they will not contaminate the aquifer.	The classification of the groundwater beneath Cape Cod as a sole-source aquifer was given consideration in the risk assessment, and therefore in the development of target cleanup levels for AOC CS-4 groundwater.

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
USEPA = U.S. Environmental Protection Agency
SDWA = Safe Drinking Water Act
ROD = Record of Decision

TABLE 12-2
CHEMICAL-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
GROUNDWATER/ SURFACE WATER				
Federal	SDWA - MCLs (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water.	To assess the potential risks to human health due to consumption of groundwater, contaminant concentrations were compared to their MCLs. When available, the MCLs were used to set clean-up levels for AOC CS-4 groundwater contaminants.
	SDWA - MCLGs (40 CFR 141.50 - 141.51)	Relevant and Appropriate	MCLGs are health-based criteria. As promulgated under SARA, MCLGs are to be considered for drinking water sources. MCLGs are available for several organic and inorganic contaminants.	The 1990 National Contingency Plan states that non-zero MCLGs are to be used as goals. Contaminant concentrations in groundwater were compared to their MCLGs when setting clean-up levels.
	RCRA - Subpart F Groundwater Protection Standards, Alternate Concentration Limits (40 CFR 264.94)	Relevant and Appropriate	This requirement outlines standards, in addition to background concentrations and MCLs, to be used in establishing clean-up levels for remediating groundwater contamination.	These requirements may be relevant and appropriate if certain conditions relating to transport and exposure are met. Because MCLs were available for most compounds, alternate concentration limits were not set.
Federal Guidance and Criteria To Be Considered	USEPA RfDs	To Be Considered	RfDs are considered the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	USEPA RfDs were used to characterize risks due to noncarcinogens in various media.
	USEPA Carcinogen Assessment Group CPFs	To Be Considered	Carcinogenic effects present the most up-to-date information on cancer risk potency derived from USEPA's Carcinogen Assessment Group.	USEPA CPFs were used to compute the individual incremental cancer risk resulting from exposure to certain compounds.
State	Massachusetts Drinking Water Standards (310 CMR 22.00)	Relevant and Appropriate	Massachusetts Drinking Water Standards with the exception of sodium are equivalent to federal MCLs. When state levels are more stringent than federal levels, the state levels may be used.	Drinking water standards, when available, were used to set clean-up levels.
	Massachusetts Groundwater Quality Standards (314 CMR 6.06)	Applicable	These standards limit the concentration of certain materials allowed in classified Massachusetts waters. The groundwater beneath MMR has been classified as a Class I water or fresh groundwater found in the saturated zone of unconsolidated deposits and is designated as a source of potable water supply.	These standards will be attained because the clean-up levels or potential discharge limits were set using these as guidelines.

continued

TABLE 12-2
CHEMICAL-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
State	Massachusetts HWMR-Maximum Concentration of Constituents for Groundwater Protection (310 CMR 30.668)	Relevant and Appropriate	This requirement established three categories of groundwater protection standards: background, concentrations, maximum concentrations, and alternate concentrations. The maximum concentrations are identical to federal SDWA MCLs.	Complying with federal MCLs as target clean-up levels will be consistent with state standards.
State Guidance and Criteria to Be Considered	Massachusetts Drinking Water Guidelines	To Be Considered	The Office of Research and Standards uses a methodology similar to the USEPA Office of Drinking Water when setting guidelines. Carcinogens have guidelines set at the lowest practical quantitation limit or a level which would pose an excess cancer risk of 10^{-6}. For noncarcinogens, a percentage (usually 20 percent) is applied to published or derived route-specific, reference doses and standard exposure assumption to derive a drinking water concentration.	In the absence of drinking water standards, these guidelines would have been considered when setting target clean-up levels or discharge limits. However, MCLs or risk-based target clean-up levels were set, for AOC CS-4 groundwater; these guidelines were not necessary to develop cleanup levels.

Notes:

ARAR = Applicable or Relevant and Appropriate Requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CPF = carcinogenic potency factor
HWMR = Hazardous Waste Management Rules
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
MMR = Massachusetts Military Reservation
OSWER = Office of Solid Waste and Emergency Response
RCRA = Resource Conservation and Recovery Act
RfD = reference dose
SARA = Superfund Amendments and Reauthorization Act
SDWA = Safe Drinking Water Act
USEPA = U.S. Environmental Protection Agency
ROD = Record of Decision

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
Federal			
OSHA - General Industry Standards (29 CFR Part 1910)	Applicable	These regulations specify the 8-hour time-weighted average concentration for various organic compounds. Training requirements for workers at hazardous wastes operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the concentration. Workers performing remedial activities would be required to have completed specific training requirements.
OSHA - Safety and Health Standards (29 CFR Part 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be available on site. In addition, safety procedures will be followed during on-site remedial activities.
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	These requirements apply to all site contractors and subcontractors, and must be followed during all site work.
RCRA - Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262)	Applicable	This requirement sets standards for generators of hazardous waste that address (1) accumulating waste, (2) preparing hazardous waste for shipment, and (3) preparing the uniform hazardous waste manifest. These requirements are integrated with DOT regulations.	If any alternative proposes shipping wastes off site, the material must be shipped in proper containers that are accurately marked and labeled, and the transporter must display proper placards. All waste shipments would accompanied by an appropriate manifest.
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-172.558)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	Hazardous and contaminated materials will be packaged, manifested, and transported to a licensed off-site disposal facility in compliance with these regulations.
Clean Air Act - National Primary and Secondary Ambient Air Quality Standards (40 CFR 50)	Applicable	Primary ambient air quality standards define levels of air quality to protect human health.	The standard for particulate matter of less than 10 microns is 150 $\mu g/m^3$, 24-hour average concentration. These standards would be adhered to for invasive construction activities.
	Applicable	Secondary ambient air quality standards protect public welfare from known or anticipated adverse effects from pollutants.	These standards would be complied with for remedial construction activities.

continued

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
State			
Massachusetts HWMR - Location Standards for Facilities (310 CMR 30.700 - 30.707)	Relevant and Appropriate	Under these standards, a new facility may not be located in an area subject to flooding; within the watershed of a Class A or Class SA segment of the surface water body unless it is determined that there is no feasible alternative; on land overlying an actual, planned, or potential public or private drinking water source; or in the flow path of groundwater supplying water to an existing well. In addition, there shall be a minimum of 300 feet from the active portion of the facility to the facility property line.	The treatment facility will be located and operated to fulfill these regulations.
Massachusetts HWMR - Requirements for Generators (310 CMR 30.300 - 30.371)	Relevant and Appropriate	These requirements are similar to the federal RCRA regulations for generators. Massachusetts specifies requirements for very small quantity generators, as well as small and large quantity generators.	When a waste or residual waste is moved, the generator requirements would be complied with.
Massachusetts HWMR - Requirements for Transporters (310 CMR 30.400 - 30.416)	Relevant and Appropriate	These regulations are similar to the federal RCRA transportation requirements. In addition, liability insurance must be obtained by all licensed hazardous waste transporters and each vehicle must have a vehicle identification device.	Hazardous materials will be transported by a licensed operator to an off-site disposal facility as specified in these requirements.
Massachusetts Groundwater Discharge Permits (314 CMR 5.00)	Relevant and Appropriate	Permit information, including conditions and variances, are specified in these regulations.	Discharge of treated water to the ground or groundwater would comply with the substantive requirements of these regulations.
Massachusetts Air Pollution Control Regulations (310 CMR 6.00 - 8.00)	Relevant and Appropriate	These regulations outline the standards for air pollution control, including particulate matter, carbon monoxide, nitrogen dioxide, and lead.	Particulate standard is 75 $\mu g/m^3$ annual geometric mean and 150 $\mu g/m^3$ 24-hour average concentration. These standards would be adhered to during construction activities.

continued

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC CS-4 GROUNDWATER RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
Implementation of M.G.L. Chapter 111F, Employee and Community Right-to-Know (310 CMR 33.00)	Relevant and Appropriate	The regulations establish rules and requirements for the dissemination of information related to toxic and hazardous substances to the public.	Information applicable to site activities and characteristics will be made available to the public.
Worker Right-to-Know (441 CMR 21.00)	Relevant and Appropriate	These regulations establish requirements for worker right-to-know.	Information applicable to site activities and characteristics will be made available to on-site workers.

Notes:

ARARs = Applicable or Relevant and Appropriate Requirements
CAA = Clean Air Act
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CWA = Clean Water Act
DOT = Department of Transportation (U.S.)
HWMR = Hazardous Waste Management Rules
LDRs = Land Disposal Restrictions
MGL = Massachusetts General Law
MMR = Massachusetts Military Reservation
NESHAP = National Emission Standards for Hazardous Air Pollutants
NPDES = National Pollutant Discharge Elimination System
OSHA = Occupational Safety and Health Administration
POTW = publicly owned treatment works
RCRA = Resource Conservation and Recovery Act
SDWA = Safe Drinking Water Act
$\mu g/m^3$ = micrograms per cubic meter
VOC = volatile organic compound
ROD = Record of Decision

appropriate and the state standards were applicable as chemical-specific requirements in determining effluent discharge limits, although the discharge will be occurring from an on-site treatment facility to the groundwater. The criteria would be met by setting effluent discharge limits, designing and constructing a treatment process to meet those levels, and by monitoring the process for compliance with the criteria.

The other requirements listed in Table 12-2 were used in the risk assessment and development of Target Clean-up Levels for those compounds that did not have promulgated drinking water standards.

12.2.3 Action-specific ARARs

Action-specific ARARs for the selected remedy are presented in Table 12-3. A summary of requirements that must be attained are discussed in the following brief descriptions.

Air Regulations. Federal and state air quality standards exist for particulate matter and would be used in assessing excavation and construction emission controls. These standards are relevant and appropriate, rather than applicable, because they were originally developed to control stack and automobile emissions. Threshold Limit Values established by OSHA regulations provide an extensive list of control levels applicable to on-site remediation activities such as installation of the extraction wells and collection network, and the treatment system. Air-related ARARs would be met through the use of engineering controls and monitoring during construction of the remedy.

Water Regulations. Substantive requirements of the Massachusetts Groundwater Discharge Permits would be relevant and appropriate to the on-site discharge of treated groundwater. The effluent from the treatment process would be monitored to evaluate compliance with these regulations.

Hazardous Waste Regulations. The off-site shipment of hazardous materials would be subject to U.S. Department of Transportation rules. If the spent carbon or other residuals are determined to be hazardous wastes, the treatment facility would have to comply with the substantive Resource Conservation and Recovery Act requirements for generators and transporters.

Other Action-specific Regulations. Federal OSHA requirements that regulate worker and employee records should be followed during all on-site work. These regulations include safety and health standards for federal service contracts and recordkeeping, reporting, and related regulations. Because these regulations govern general working conditions within industry and provide minimum protection standards for workers involved in remedial actions, these regulations are applicable.

Massachusetts has hazardous substance right-to-know regulations that establish requirements to protect the health and safety of employees and community residents through the communication of information regarding toxic and hazardous substances. These regulations are relevant and appropriate to on-site workers during the interim remedial action.

12.3 THE SELECTED INTERIM REMEDIAL ACTION IS COST-EFFECTIVE

In the NGB's judgment, the selected remedy affords overall effectiveness proportional to its costs. Once the NGB identified alternatives that are protective of human health and the environment and that attain ARARs, the NGB evaluated the overall effectiveness of each alternative by assessing the three relevant criteria:

- reduction in mobility, toxicity, and volume through treatment
- short-term effectiveness
- long-term effectiveness and permanence

The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs. The costs of this interim remedial alternative are as follows:

Estimated Capital Cost: $1,641,000 to $3,516,000

Estimated Operations and Maintenance Cost (net present worth):* $472,000 to $1,012,000

Estimated Total Cost (net present worth):* $2,112,000 to $4,528,000

*Net present worth costs are based on a 10 percent discount factor and five years of operation.

12.4 THE SELECTED INTERIM REMEDY UTILIZES PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The NGB identified which alternative uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by identifying an alternative that provides the best balance of trade-offs in terms of the following criteria:

- long-term effectiveness and permanence
- reduction of mobility, toxicity, or volume through treatment
- short-term effectiveness
- implementability
- cost

The balancing test emphasized long-term effectiveness, permanence, and the reduction of mobility, toxicity, and volume through treatment. This interim test also considered the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives, given the limited scope of the interim action selected. Consideration of long-term effectiveness does not apply due to the short-term nature of the selected remedy. The selected remedy will achieve reduction of mobility, toxicity, or volume through treatment of extracted groundwater, thereby reducing migration of contaminants. The selected interim remedy would have no implementation difficulties. Carbon adsorption technology is well demonstrated and the equipment is readily available. The selected remedy will achieve the goals of the interim action; that is, reduction of contaminant migration and collection of further data to characterize the AOC CS-10 groundwater plume for use in selecting the final remedy, while costing the least of the active interim options.

12.5 THE SELECTED INTERIM REMEDY SATISFIES THE PREFERENCE FOR TREATMENT WHICH PERMANENTLY AND SIGNIFICANTLY REDUCES THE MOBILITY, TOXICITY, OR VOLUME OF THE HAZARDOUS SUBSTANCES AS A PRINCIPAL ELEMENT

The principal element of the selected remedy is the extraction and treatment of groundwater at the leading edge of the AOC CS-4 contaminated groundwater plume and its subsequent discharge to on-site infiltration trenches. This element addresses the primary exposure pathway at the site for this operable unit: contamination of groundwater. The selected remedy satisfies the statutory preference for reduction in the mobility, toxicity, or volume to the extent possible in light of its limited scope by extracting and treating contaminated groundwater and preventing its further migration to downgradient areas. This interim ROD will be followed by a final ROD that will determine what further actions, if any, will be necessary to meet the preference for treatment that will permanently and significantly reduce the mobility, toxicity, or volume of hazardous substances.

13.0 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The NGB presented a Proposed Plan for remediation of AOC CS-4 in February 1992. The management of migration portion of the preferred alternative included extraction of contaminated groundwater, treatment of the collected groundwater, and discharge of the treated groundwater to an infiltration basin on MMR property. There have been no significant changes made to the plan as stated in the Proposed Plan of February 1992 (ABB Environmental Services, Inc., 1992b).

14.0 STATE ROLE

MADEP, on behalf of the Commonwealth of Massachusetts, reviewed the various alternatives and indicated its support for the selected interim remedy. MADEP also reviewed the FFS to determine if the selected remedy is in compliance with applicable or relevant and appropriate state environmental regulations. MADEP concurs with the selected remedy for AOC CS-4 groundwater. A copy of the declaration of concurrence is in Appendix B.

ABB Environmental Services, Inc., 1991. "Study Areas CS-4, FS-25, and FTA-1 Engineering Evaluation/Cost Analysis Report"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; June 1991.

ABB Environmental Services, Inc., 1992a. "Groundwater Focused Feasibility Study, West Truck Road Motor Pool (AOC CS-4)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; February 1992.

ABB Environmental Services, Inc., 1992b. "Groundwater Proposed Plan, West Truck Road Motor Pool (AOC CS-4)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; February 1992.

Army Environmental Hygiene Agency (AEHA), 1986. "U.S. Army Environmental Hygiene Agency Geohydraulic Study No. 38-26-0500-86; Camp Edwards, Massachusetts; July 8-10 and September 9-17, 1985"; April 1986.

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

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

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

E.C. Jordan Co., 1990a. "Site Inspection Report, Field Investigation Work Conducted Spring-Summer 1988, Task 2-3B"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; February 1990.

E.C. Jordan Co., 1990b. "Technical Memorandum, Phase II Investigations of the MW-603 Groundwater Study"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; February 1990.

E.C. Jordan Co., 1990c. "Technical Report, Phase I of the MW-603 Groundwater Study (Study Area CS-4, West Truck Motor Pool, Groundwater Operable Unit)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; March 1990.

E.C. Jordan Co., 1990d. "Focused Feasibility Study, West Truck Road Motor Pool Site: Study Area CS-4, Source Control Operable Unit"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; June 1990.

U.S. Environmental Protection Agency (USEPA), 1986. "Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Final Exclusion and Final Organic Leachate Model (OLM)"; Code of Federal Regulations, Title 40, Part 261; Final Rule; *Federal Register;* Vol. 51, No. 219; November 13, 1986.

U.S. Environmental Protection Agency (USEPA), 1989. "Determining Soil Response Action Levels Based on Potential Contaminant Migration to Ground Water: A Compendium of Examples"; USEPA 540/2-89/057.

U.S. Environmental Protection Agency (USEPA), 1990. "National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan)"; Code of Federal Regulations, Title 40, Part 300; March 8, 1990; Final Rule; *Federal Register;* Vol. 55, No. 46; pp. 8666 *et seq.*

AEHA	Army Environmental Hygiene Agency
ANG	Air National Guard
AOC	Area of Contamination
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DCE	dichloroethylene
DOD	Department of Defense (U.S.)
DPDO	Defense Property Disposal Office
EE/CA	engineering evaluation/cost analysis
FFS	focused feasibility study
ft/yr	feet per year
gpm	gallons per minute
HI	Hazard Index
IRP	Installation Restoration Program
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MMR	Massachusetts Military Reservation
NCP	National Contingency Plan
NGB	National Guard Bureau
NPL	National Priorities List
OLM	Organic Leachate Model
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethylene

RfD	reference dose
ROD	Record of Decision
SDWA	Safe Drinking Water Act
TCE	trichloroethylene
TEAC	Technical Environmental Affairs Committee
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound

STATE CONCURRENCE LETTER

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

Ms. Julie Belaga
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and

Mr. Ronald Watson
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RE: BOURNE--BWSC SA4-0037
Massachusetts Military Reservation (MMR) Area of Contamination Chemical Spill-4 (CS-4) Groundwater Interim Record of Decision Concurrence

May 18, 1992

Dear Ms. Belaga and Mr. Watson:

The Department of Environmental Protection (DEP) has reviewed the preferred remedial action alternative recommended by the National Guard Bureau and the U.S. EPA for an interim cleanup of the CS-4 groundwater contaminant plume at the MMR National Priorities List Site.

The DEP has evaluated the preferred alternative for consistency with M.G.L. Chapter 21E and the Massachusetts Contingency Plan. The proposed alternative is a groundwater containment action that addresses the continued downgradient migration of contaminated groundwater originating at CS-4. The interim remedy consists of approximately 13 extraction wells positioned across the width and depth of the plume. The extraction wells will be equidistant from one another, located 60 feet apart, and will pump a combined flow rate of 115 gpm. The extracted groundwater will be treated with granular activated carbon to remove volatile organic compounds and clean water will be discharged through infiltration trenches.

The interim remedy will be operated for a minimum of five years, during which time the CS-10 groundwater contaminant plume, known to be located upgradient from the CS-4 plume, will be fully characterized and options for remediation evaluated. A final remedy will be determined to address the CS-4 and CS-10 groundwater plumes.

The DEP has determined that the interim remedy is a remedial action on a portion of the disposal site which would be consistent with a future permanent solution for the entire disposal site. However, a permanent solution determination cannot be made until it has been demonstrated that the remedial response action or combination of actions will meet the Total Site Risk Limits as defined in the Massachusetts Contingency Plan (MCP) 310 CMR 40.00 for the site.

The DEP has identified the MCP and M.G.L. Chapter 21E as applicable requirements, within the meaning of CERCLA, for the CS-4 Groundwater Operable Unit of the MMR National Priorities List Site. The selected remedy appears to meet all Massachusetts state Applicable or Relevant and Appropriate Requirements (ARARs). The DEP will continue to evaluate compliance with ARARs as remedial design progresses and during implementation and operation.

The DEP looks forward to working with you in implementing the preferred alternative and facilitating an expeditious cleanup of the MMR site. If you have any questions please contact James F. Begley at (508) 946-2871.

Very truly yours,

Daniel S. Greenbaum, Commissioner
Department of Environmental Protection

cc: BWSC Boston
TEAC Distribution