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FINAL
REMEDIAL ACTION REPORT
AREA OF CONTAMINATION 69W

DEVENS RESERVE FORCES TRAINING AREA
DEVENS, MASSACHUSETTS

CONTRACT DACA87-02-D-0007
DELIVERY ORDER NO. DB01

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

APRIL 2004

PRINTED ON RECYCLED PAPER

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Prepared for:

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

Prepared by:

MACTEC Engineering and Consulting, Inc.
Portland, Maine

APRIL 2004

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Principal Engineer

Patricia Lyman
Project Engineer

Final Remedial Action Report
Record of Preparation, Review, and Approval

Area of Contamination 69W
Devens Reserve Forces Training Area
Devens, Massachusetts

This Final Remedial Action Report was prepared according to EPA OSWER Directive 9320.2-09A-P, dated January 2000. This report will be used, along with previous and future remedial action reports for other relevant sites at Devens and Five-Year Review Reports, as the basis for the development of the Preliminary and Final Close Out Report.

Approved By:	Signature Dr. Benjamin F. Goff BRAC Environmental Coordinator Devens Reserve Forces Training Area Date:
Approved By:	Signature: Ms. Carol Keating Remedial Project Manager U.S. Environmental Protection Agency Date:
Approved By:	Signature: Ms. D. Lynne Welsh Section Chief, Federal Facilities, Central Regional Office Massachusetts Department of Environmental Protection Date:

APRIL 2004

FINAL
REMEDIAL ACTION REPORT
AREA OF CONTAMINATION 69W

DEVENS RESERVE FORCES TRAINING AREA
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EXECUTIVE SUMMARY

This Final Remedial Action Report updates the Interim Remedial Action Report prepared for Area of Contamination (AOC) 69W at Devens Reserve Forces Training Area (RFTA) (the former Fort Devens), Devens, Massachusetts by the U.S. Army Corps of Engineers (USACE) in 2002. The USACE was and remains the contracting party responsible for remedial/removal action design and implementation at AOC 69W and is the party most familiar with the site. This report was prepared by MACTEC Engineering and Consulting, Inc. under contract to USACE. MACTEC completed the Remedial Investigation of AOC 69W and is also familiar with the site.

Fort Devens was placed on the National Priorities List on December 21, 1989, under the Comprehensive Environmental Response Compensation and Liability Act. This report will be used, along with previous and future remedial action reports for other relevant sites at Devens RFTA and Five-Year Review Reports, as the basis for the development of the Preliminary and Final Close Out Report. The Army is the lead federal agency responsible for environmental cleanup at Devens RFTA. The CERCLIS ID for the site is MA7210025154.

AOC 69W is the site of the former Fort Devens Elementary School which now operates as the Town of Ayer Parker Charter School. Contamination at the site is attributed to heating oil, which leaked from underground piping in two separate incidences in 1972 and 1978. It is estimated that approximately 7,000 to 8,000 gallons of fuel oil were released into the soil from each incident. A subsurface oil recovery system was installed in 1972 to capture as much of the 1972 spill as possible and remained in place until 1998. In 1998, a Time-Critical Removal Action was completed, and approximately 3,500 cubic yards of soil with petroleum contamination exceeding the Massachusetts Contingency Plan Method 1 S-1/GW-1 soil standards were excavated. In addition, a 10,000-gallon fuel oil underground storage tank and the subsurface oil recovery system were also removed.

A Record of Decision for AOC 69W which required implementation of long-term groundwater monitoring, institutional controls to limit potential exposure to contaminated soil and groundwater, and performance of Five-years Reviews was signed in 1999, and in 2000, semiannual groundwater monitoring was initiated as part of the long-term monitoring plan for AOC 69W. Review of monitoring data shows that nine of ten monitoring wells attain cleanup goals for EPH and VPH. EPH concentrations in one well exceed the EPH aromatic C11 – C19 cleanup goal of 200 micrograms per liter (µg/L), but have decreased 87 percent from 2,500 to 330 µg/L and continue to show a decreasing trend. Four monitoring wells show exceedences of the arsenic and manganese cleanup goals. However, the presence of both these elements in groundwater is believed driven by reductive dissolution from overburden soils as a result of the aerobic biodegradation of fuel compounds. Monitoring data show the ongoing cleanup of fuel at AOC 69W, and arsenic and manganese concentrations are expected to decrease after fuel degradation is complete.

The remedial components required by the Record of Decision have been implemented and are functioning as intended.

1.0 INTRODUCTION

This Final Remedial Action Report was prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the U. S. Army Corps of Engineers (USACE) New England District in partial fulfillment of Contract DACA87-02-D-0007 Delivery Order DB01. This Final Remedial Action Report updates the Interim Remedial Action Report prepared by USACE on 2002. The USACE was and remains the contracting party responsible for remedial/removal action design and implementation at Area of Contamination (AOC) 69W at Devens Reserve Forces Training Area (RFTA), Devens, Massachusetts and is the party most familiar with the site. MACTEC (formerly known as Harding Lawson Associates, Inc.), under contract to USACE, completed the Remedial Investigation of AOC 69W and is also familiar with the site.

Fort Devens was placed on the National Priorities List on December 21, 1989, under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act. The Army is the lead federal agency responsible for the cleanup and funding is from the Department of Defense. The CERCLIS ID for the site is MA7210025154.

1.1 INSTALLATION HISTORY

The former Fort Devens is located approximately 35 miles west of Boston in the towns of Ayer and Shirley (Middlesex County) and Harvard and Lancaster (Worcester County), (Figure 1). It was created as a temporary cantonment in 1917 for training soldiers from the New England area. From 1922 to 1931, it was a training camp for various troops. In 1929, Dr. Robert Goddard tested his early rockets there. The installation was formally dedicated as Fort Devens in 1932. In 1940, Fort Devens became a reception center and encompassed more than 10,000 acres. A hospital and airfield were built. Inductees were processed there throughout WWII, and it had a peak population of 65,000. At the end of the war, Fort Devens became a demobilization center and reverted to caretaker status in 1946.

Fort Devens was reactivated in 1948 because of the Korean War. It maintained its function as a training and induction center and as a mobilization and demobilization site during the Korean and Vietnam conflicts, and Operations Desert Shield and Desert Storm. Fort Devens was identified for cessation of operations and closure under Public Law 101-510, the Defense Base Closure and Realignment Act of 1990, and was officially closed in September 1996. Portions of the property formerly occupied by Fort Devens were retained by the Army for reserve forces training and renamed the Devens RFTA. Areas not retained as part of the Devens RFTA were, or are in the process of being, transferred to new owners for reuse and redevelopment.

The installation developed on what were primarily open farm lands and forested areas. It was divided into North, Main, and South Posts (Figure 2). Over 6,000 acres at Fort Devens were used for training and military maneuvers, and over 3,000 acres were developed for housing,

buildings, and other facilities; the installation has been reported as the largest undeveloped land holding under a single owner in north-central Massachusetts (United States Fish and Wildlife Service [USFWS], 1992).

No major industrial operations occurred at Fort Devens, although several small-scale industrial operations were performed under the Directorate of Plans, Training, and Security; the Directorate of Logistics; and the Directorate of Engineering and Housing. The major waste-producing operations performed by these groups were photographic processing and maintenance of vehicles, aircraft, and small engines. Past artillery fire, mortar fire, and waste explosive disposal at Fort Devens are potential sources for explosives contamination (USAEC, 1993).

1.2 LOCATION, SETTING, AND HISTORY OF AOC 69W

1.2.1 Location

AOC 69W is located on the former Main Post at the northeast corner of MacArthur Avenue and Antietam Street (see Figure 2). AOC 69W comprises the former Fort Devens Elementary School (Building 215) and the associated parking lot and adjacent lawn extending approximately 300 feet northwest to Willow Brook. Site features and monitoring wells are shown on Figure 3. A typical geologic cross section is presented in Figure 4. AOC 69W is located in an area planned for transfer to MassDevelopement for reuse as educational, cultural, institutional, and office space.

1.2.2 Setting

The topography at AOC 69W is, in general, relatively flat, sloping gently towards Willow Brook which abuts the west and northwest portions of the site. A small, wooded, grassy wetland area is located to the northwest and north. The northern portion of the site is an asphalt parking lot that extends approximately 120 feet before grading into a grassy area. The eastern portion of the site is a combination of asphalt pavement and grass. A small section of the southern portion of AOC 69W is asphalt paved followed by a steep grassy embankment leading up to Antietam Street. The west side of the site is a combination of asphalt pavement and grass leading to Willow Brook.

1.2.3 History

General events in the site history are presented in Table 1.

TABLE 1 - AOC 69W OPERATING HISTORY

Date	Event
1951	The Fort Devens Elementary School was built and consisted of the east/southeast half of the present school. The school was heated by an oil-fired boiler, and the heating oil was stored in a 10,000-gallon underground storage tank (UST) located in what is currently the school courtyard. The school was operated and maintained by the Ayer School Department.
1972	An addition to the school was built which formed the current school structure. Although a new boiler room was constructed, the old boiler room remained operational. The original 10,000-gallon UST was removed, and a new 10,000-gallon UST was installed north of the school in the middle of the current parking lot.
1972	During the UST installation, the underground fuel line leading to the new boiler room was accidentally crimped, causing the pipe to split and leak approximately 7,000 to 8,000-gallons of No. 2 fuel oil to the ground.
1972 - 1973	As a result of the fuel release, an oil recovery system was installed in the vicinity of the 10,000-gallon UST. The system consisted of underground piping connected to a buried 250-gallon concrete vault that acted as an oil/water separator. The vault collected oily water and was pumped out approximately every three months.
1978	Underground fuel piping near the old boiler room failed at a pipe joint. Approximately 7,000 to 8,000-gallons of oil were released into the soil during the incident. Soil was excavated to locate the source of the release. The excavation was used to collect the residual oil for one month before the damaged piping was found and replaced. A minimum of 2,600-gallons of residual oil was pumped from the oil recovery system.
Post 1986	The 250-gallon oil/water separator was filled with crushed rock.
1989	Fort Devens is placed on National Priorities List under CERCLA.
1993	The Ayer School Department closed the school because the facility was excess to its needs. As part of the Base Closure process the Army conducted a base-wide evaluation of past spill sites and designated the elementary school spill site as Area Requiring Environmental Evaluation (AREE) 69W. Based on document reviews and site visits, the evaluation concluded that residual fuel contamination may have been present in the soil and groundwater at the site.
1994	The Army performed a Site Investigation (SI) which revealed the presence of fuel-related contaminants in both soil and groundwater between the school and the existing fuel UST, and in an area extending northwest from the existing fuel UST to near Willow Brook. The Army redesignated the site as AOC 69W and proposed that a RI be performed.

Date	Event
1995 - 1998	A RI was conducted to define the distribution of contaminants previously detected in the soil and groundwater during the AREE 69W SI, and to determine whether remediation was warranted. The RI data showed that fuel-related compounds, primarily total petroleum hydrocarbons (TPH) and semivolatile organic compounds (SVOCs) were present in soils extending from the new (1972) boiler room to approximately 300 feet northwest. The observed groundwater contaminants consisted of fuel-related volatile organic compounds (VOCs), SVOCs, TPH, and inorganics. Soil and groundwater contamination appeared to be largely a result of the 1972 fuel oil release. The underground oil recovery system apparently acted as a conduit for contaminant migration in soil and groundwater. Observed contamination from the 1978 release did not appear to be migrating downgradient and further migration was unlikely
1996	Fort Devens was officially closed. AOC 69W was slated for future transfer to the Massachusetts Government Land Bank. The existing school building was expected to be re-opened in the near future.
1997 -1998	Based on a review of the soil and groundwater contaminant data, the Army performed a removal action and excavated approximately 3,500 cubic yards (cy) of petroleum-contaminated soil associated with the 1972 fuel oil leak. The 10,000-gallon fuel oil UST and the oil recovery system's 250-gallon vault and associated piping were also removed. The 10,000-gallon fuel oil UST was confirmed to be intact. Confirmatory soil sampling in excavated areas indicated that extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) concentrations immediately adjacent to the school still exceeded the Massachusetts Contingency Plan (MCP) Method 1 S-1/GW-1 soil standards after the removal action. Because of to the proximity of the school, this soil could not be excavated without potential structural damage to the building. Because the area is paved, there is minimal potential for further migration of contaminants and future exposure.
1998	The Final RI Report was issued. Based on the results of the RI and Removal Action, the Army, along with the USEPA and MADEP, concluded that under current conditions and uses, including re-use as a school, AOC 69W did not present unacceptable risks to human health or the environment and that a feasibility study to evaluate remedial action alternatives was not needed.
1999	The Proposed Plan detailing the Army's plan for Limited Action at AOC 69W was issued for public comment.
1999	A Limited Action Record of Decision (ROD) was signed. The Limited Action consisted of long-term groundwater monitoring and institutional controls to limit the potential exposure to contaminated soil and groundwater under current and future site conditions.
2000	The former Fort Devens Elementary School was reopened as Parker Charter School.
2000	Final Long-term Monitoring Plan (LTMP), AOC 69W is issued.
May 2000	Long-term monitoring initiated, semi-annual groundwater monitoring conducted.
Nov. 2000	Semi-annual groundwater monitoring is conducted.
April 2001	2000 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2001	Semi-annual groundwater monitoring is conducted.
Nov. 2001	Semi-annual groundwater monitoring is conducted.

Date	Event
April 2002	2001 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2002	Semi-annual groundwater monitoring is conducted.
Nov. 2002	Semi-annual groundwater monitoring is conducted.
April 2003	2002 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2003	Semi-annual groundwater monitoring is conducted.
Nov. 2003	Semi-annual groundwater monitoring is conducted.
April 2004	2003 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.

1.3 AOC 69W CONTAMINATION, INVESTIGATION, AND CLEAN-UP HISTORY

Contamination at the site is attributed to heating oil, which leaked from underground piping in two separate incidences in 1972 and 1978. It is estimated that approximately 7,000 to 8,000 gallons of fuel oil were released into the soil from each incident. In 1998, a Time-Critical Removal Action was performed, and approximately 3,500 cy of petroleum-contaminated soil were excavated. In addition, the 10,000-gallon fuel oil UST and the oil recovery system's 250-gallon vault and associated piping were also removed. The school was closed for a period of time and was reopened in September 2000 as the Parker Charter School. A summary of the details of the site investigation, enforcement and cleanup is presented in Table 2.

TABLE 2 - MAJOR INVESTIGATION, ENFORCEMENT, AND CLEANUP MILESTONES AT AOC 69W

Date	Event
1993	A document review of the Elementary School, designated AREE 69W, was performed and focused on the 1978 on spill. The review concluded there was potential for contamination in soil and groundwater.
1994	Further investigation was performed at AREE 69W which included sampling, field screening, and laboratory analysis of surface soil, subsurface soil, groundwater, surface water, and sediment, and a geophysical survey to locate subsurface utilities. It was concluded that TPH and carcinogenic polynuclear aromatic hydrocarbon (cPAH) soil contamination appeared to be concentrated in the area of the existing UST, and may have migrated downgradient towards Willow Brook. Groundwater northwest of the UST was also found to have elevated concentrations of inorganics and TPH, suggesting that contaminants had migrated downgradient of the UST location.

Date	Event
1995 - 1997	An RI field program consisting of several field efforts was initiated. The initial RI field effort was performed in the fall of 1995. As a result of the findings of this field effort, additional work was determined necessary to characterize contaminant distribution at AOC 69W. Additional phases of work were performed in the falls of 1996 and 1997. The RI field program for AOC 69W included a geophysical survey; twenty-nine TerraProbe^{SM} points; three soil borings; eight surface soil samples; nine sediment and three toxicity test samples collected in Willow Brook; installation and development of seven monitoring wells and two piezometers; two rounds of groundwater samples collected from the newly installed and previously existing monitoring wells, and two supplemental rounds of groundwater sampling using low-flow techniques; one test pit; indoor air sampling inside the elementary school; aquifer testing on the new and existing monitoring wells; and horizontal and vertical survey of all RI explorations.
1997 -1998	Roy F. Weston, Inc. (R.F. Weston) removed approximately 3,500 cy of petroleum-contaminated subsurface soil associated with the 1972 fuel oil leak, and removed the 10,000 gallon UST, the 250 gallon vault, and the associated piping that may have served as a potential conduit to downgradient areas.
May 2000	Long-term monitoring initiated, semi-annual groundwater monitoring conducted.
Nov. 2000	Semi-annual groundwater monitoring is conducted.
April 2001	2000 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2001	Semi-annual groundwater monitoring is conducted.
Nov. 2001	Semi-annual groundwater monitoring is conducted.
April 2002	2001 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2002	Semi-annual groundwater monitoring is conducted.
Nov. 2002	Semi-annual groundwater monitoring is conducted.
April 2003	2002 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.
May 2003	Semi-annual groundwater monitoring is conducted.
Nov. 2003	Semi-annual groundwater monitoring is conducted.
April 2004	2003 Annual Report for AOC 69W Long-term Groundwater Monitoring is issued.

1.4 REMOVAL ACTION DETAILS

In December 1997, the Massachusetts Department of Environmental Protection (MADEP) and the U.S. Environmental Protection Agency (USEPA) approved the proposed removal of the 10,000-gallon UST, 1,200 cy of petroleum-contaminated soil from hot spot adjacent to the UST location, underground piping from the "skimmer system", and the underground vault. The areas affected by excavations are depicted on Figure 5. The scope of the removal actions performed at AOC 69W is described below.

A time-critical removal action was initiated in January 1998 (R. F. Weston, 1998). The removal action encompassed an area approximately 120 by 180 feet immediately north of the elementary school. A narrow "extension" of the removal action reached as far as Willow Brook to the northwest, past the 250 gallon underground vault. Visual inspection of the 10,000 gallon UST confirmed that it was intact (i.e., no holes or leaks were observed). A summary of removal activities is presented in Table 3.

TABLE 3 - REMOVAL ACTION/SITE DETAILS

Underground vault removal	Top of concrete ~1.5 feet below ground surface (bgs). Vault circular ~5 by 5 ft. Filled with stone and soil. Heavy petroleum contamination in bottom 2 ft. Water table ~4 feet bgs. Excavation continued to 7 feet bgs. Sidewall towards Willow Brook showed some staining. Excavation removed 3-4 feet of sidewalls until field screens showed soils below 1,000 parts per million (ppm) TPH. Transite pipe found (6-inch diameter) at 2 feet bgs ~15 feet long, ending 5 feet from Willow Brook. At conclusion, slight oily sheen on groundwater adsorbed with pads. Confirmatory soil samples collected from sidewalls and from floor.
Underground pipe and trench excavation	Digging traced pipe from UST area in the parking lot of the school from the concrete vault. Trench then excavated to a depth of 1 foot below pipe bottom extending 4 feet on either side. All pipe sections upstream of vault were clay. Some local contamination from leaks. Pipe was ~5 feet bgs at edge of parking lot. Trench excavation was widened and deepened until all soils showing contamination above 1,000 ppm by non-dispersive infrared detection (NDIR) field screening were removed.
UST removal and disposal	10,000 gallon UST in the parking lot north of the school contained oily water. Contents pumped out ~660 gallons, and UST cleaned and removed. 6-8 inches of pavement removed; no evidence of petroleum contamination except near fill pipe. No evidence of leaks or deterioration in walls. UST top 2 feet bgs; bottom ~9 feet bgs. Groundwater ~8 feet bgs. Feed and return lines removed to edge of excavation adjacent to loading dock and remaining sections crimped. No product emanating. UST was strapped to concrete pad ~15 by 20 ft.
UST area excavation	• Sandy soils with no staining or petroleum odor. No headspace readings registered. East sidewall had some pockets of contamination at 7-9 feet that were removed. Excavation advanced an additional 3-4 feet into sidewall to depth of 10 feet bgs (2 feet below water table) until NDIR screening showed readings well below 1,000 ppm. North, west, and south sidewalls showed pockets with dark staining at 7-10 feet bgs; TPH field screens exceeding 5,000 ppm. Well 69W-94-11 destroyed. • Additional soils removed below the concrete pad. No field screening TPH concentration above 1,000 ppm. Samples from floor and one from east sidewall sent off-site for EPH/VPH. • Two brass pipes found at 7 feet bgs on south side of the excavation. Found terminated on the west side of the UST location. No free product found.

Hot spot excavation	• RI data showed soil contamination hot spot around well 69W-94-10. Planned to remove 1,200 cy soil at UST and hot spot. Excavated 3,500 cy following soils above 1,000 ppm by NDIR field screening. Pavement removed to the planned boundaries. Soils were field screened at one sample per 15-20 cy. Soils above 4 feet bgs did not exhibit staining, odor, or headspace above 10 ppm. Soils generally contaminated from 5-6 feet bgs to 10-11 feet bgs. Field screened by headspace and NDIR. • Excavation of the floor continued to 2-3 feet below water table. At ~11 feet bgs (2-3 feet below water table), silty soils did not show staining or odor. Confirmed by field screens. Excavation stopped at maximum safe depth of excavation. • South sidewall TPH exceeded 5,000 ppm. Excavation could not advance because of the building. Contamination appeared concentrated at 7-11 feet bgs, heaviest at 8-11feet bgs. • West side excavation continued beyond the pipe trench until TPH less than 1,000 ppm by NDIR. Confirmatory sidewall samples taken at 5-8 feet bgs for off-site EPH /VPH analyses. In first round, one sample exceeded MCP S1/GW1 standard for C9-C19 aliphatics at 2200 ppm and for C11-C22 aromatics at 520 ppm. Additional soils excavated; results were below standards for EPH/VPH. • East side excavation did not advance beyond the loading dock as determined by NDIR field screening. • Excavation on the north side removed visible petroleum contamination on the sidewall to approximately 50 feet northward of wells 69W-94-12 and 69W-94-13. • During excavation, oily sheen developed on groundwater. Sorbent pads and booms were used. Approximately 1,900 gallons of oily water were pumped from the excavation.
Underground pipe investigation	At the conclusion of excavation, the section of pipe remaining under the school building was ~6 inches above the water table (~8 feet bgs). Pipe not discharging anything. The length and direction of the pipe under the building was investigated. Smoke test showed no smoke entering the building. Other tests included introducing soapy water and foam, a video inspection during high water table (very poor visibility), and a high-pressure wash test (no evidence in drains and sumps). Pipe was filled with 5 cy of tremie concrete.
March 1998 Backfilling operations	Samples sent to off-site lab for VOCs, SVOCs, polychlorinated biphenyls, total Resource Conservation and Recovery Act (RCRA) Metals, and TPH. Passed standards. The concrete vault excavation and the underground pipe trench upstream of the vault were backfilled with imported gravel. The remaining excavation backfilled with on-site material.

2.0 AOC 69W RECORD OF DECISION BACKGROUND

2.1 REMEDY COMPONENTS

Based on results from the RI, supplemental sampling, and the soil removal action, the RI report recommended long-term monitoring of groundwater quality with no additional investigation or remedial action. No Feasibility Study was performed. The ROD for AOC 69W was signed on June 29, 1999. A Limited Action alternative was the selected remedy for groundwater and subsurface soils. It specified the following key components:

- Development of a LTMP to monitor for any potential off-site migration of contaminants and to verify that elevated concentrations decrease over time. Anticipated monitored analytes were arsenic and MADEP EPH/VPH.
- Establishment and enforcement of institutional controls, including deed and/or use restrictions, to restrict or prevent potential human exposure to site soil and groundwater contaminants left in place.
- Performance of five-year reviews to review the data collected and to assess the effectiveness of the remedy.

No remedy design or construction activities were required in the ROD.

2.2 REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) as stated in the ROD are:

- Restore the aquifer to drinking water standards within a reasonable timeframe.
- Monitor potential future migration of groundwater contamination.
- Eliminate risk from potential consumption of groundwater.
- Reduce or eliminate the direct contact threat of contaminated soils.

The RAOs are based on potential health risks to individuals in current and future use scenarios (i.e., maintenance worker and elementary school children scenarios) at the site. Site risk was attributed to arsenic in groundwater used as a potable water source. The rationale for the limited action alternative is:

- The groundwater will not be used as a drinking water source. Because the Town of Devens has a municipal water supply, groundwater poses no threat to human health or the environment.

- The Army will monitor arsenic and EPH/VPH levels in groundwater and will place institutional controls on the property to ensure current and future protectiveness.

3.0 CONSTRUCTION ACTIVITIES, CHRONOLOGY OF EVENTS, AND CONSTRUCTION QUALITY CONTROL

3.1 RECORD OF DECISION

The ROD requires no remedy design and construction. The long-term monitoring program that includes the evaluation of the institutional controls began in May 2000.

3.2 LONG-TERM MONITORING PLAN

The LTMP for AOC 69W was approved in March 2000 (HLA, 2000a). The LTMP specified sampling of eight groundwater monitoring wells (nine wells the first round) to monitor for off-site migration of contaminants of concern (COCs) and to verify that COCs decrease over time. Three of the eight wells were to be newly installed. The wells originally proposed for monitoring are described in Appendix C. Wells were to be monitored twice annually for EPH, VPH, iron, manganese, arsenic, and bis(2-ethylhexyl)phthalate. Subsequent changes in the program are described in Subsection 4.1.

3.3 INSTITUTIONAL CONTROLS

Institutional controls ensure that the remaining contaminated soils beneath and adjacent to the building are controlled and the extraction of groundwater from the site for industrial and/or potable water supply is not permitted. They are to be incorporated either in full or by reference into all deeds, easements, mortgages, leases or any other instruments of transfer prior to the transfer of the property to MassDevelopment. In the five-year review process, existing land use is evaluated to ensure control requirements are being met.

The Parker Charter School currently occupies the property. MassDevelopment supplies potable water to the school. USACE staff has observed no excavations within the Excavated Soil Management Area (ESMA) (Figure 6) during any long-term sampling event. In addition, no penetrations through the pavement or re-paved pavement cut marks have been observed within the ESMA. No groundwater extraction wells have been installed on the site.

3.4 LONG-TERM MONITORING EVENTS

Activities performed to date for the Long-term Monitoring Program are summarized in Table 4.

TABLE 4 - LONG-TERM MONITORING EVENTS FOR AOC 69W

Date	Action
June 29, 1999	ROD for AOC 69W signed
March 2000	LTMP submitted

May 2000	First long-term monitoring sampling round performed
September 2000	First Five-Year Review Report submitted
November 2000	Long-term monitoring sampling round performed
April 2001	2000 Annual Report for AOC 69W submitted
May 2001	Long-term monitoring sampling round performed
October 2001	Two new monitoring wells installed in the northern part of the site to serve as sentry wells
November 2001	Long-term monitoring sampling round performed
April 2002	2001 Annual Report for AOC 69W submitted
May 2002	Long-term monitoring sampling round performed
November 2002	Long-term monitoring sampling round performed
April 2003	2002 Annual Report for AOC 69W submitted
May 2003	Long-term monitoring sampling round performed
November 2003	Long-term monitoring sampling round performed
April 2004	2003 Annual Report for AOC 69W submitted

3.5 CONSTRUCTION QUALITY CONTROL

No remedial construction was performed. The Army performed Quality Assurance/Quality Control (QA/QC) for the long-term monitoring activities. The Army sampling teams followed protocols and QC measures stated in the LTMP. The groundwater sampling and testing program includes split and duplicate samples that are analyzed by an independent laboratory. A chemist prepared reports on the QA comparisons that were included in each annual report.

4.0 PERFORMANCE STANDARDS, REMEDY OBJECTIVES, INSPECTION AND CERTIFICATIONS.

4.1 PERFORMANCE STANDARDS

There was no Feasibility Study and the ROD did not specify a timeframe for groundwater restoration (i.e., attaining cleanup goals). The components of the selected Limited Action remedy are institutional controls, long-term groundwater monitoring, and five-year reviews. The stated expected outcome of this alternative is restoration of the aquifer to drinking water standards within a "reasonable time frame." The estimated total costs stated in the ROD are $23,300 in capital costs and $172,000 for operation and maintenance

Nine monitoring wells, including a background well, four source area wells and four sentry wells, were sampled initially. In the May 2000 sampling round, results for well ZWM-96-19X (boiler room) continued to be below cleanup goals and the well was dropped from further monitoring in accordance with the LTMP. Two new sentry wells (ZWM-01-25X and ZWM-01-26X) were installed in October 2001 after results from sentry well ZWM-99-23X showed exceedances that negated its function as a sentry well. Refer to Appendix C for a summary description of the monitoring wells used for long-term monitoring.

The COCs for this site are VPH and EPH, arsenic, and manganese. Iron is no longer a COC, as recommended in the first Five-Year Review Report (HLA, 2000b). The SVOC bis(2-ethylhexyl)phthalate was initially analyzed for in wells ZWM-95-17X and ZWM-99-22X. Initial results suggested its presence was not site related, and it was eventually dropped from future testing rounds.

The following is a summary of the sampling results to date after eight semi-annual sampling events. These results are presented numerically in Appendix D, Table D-2 and graphically in Graphs D-1 through D-12.

EPH (C11-C22 range only)

- EPH in two source wells (69W-94-13 and ZWM-99-22X) exceeded the 200 micrograms per liter (µg/L) goal for C11-C22 aromatics in each round prior to May 2003. Concentrations ranged from 210 to 2,500 µg/L. However, results from 69W-94-13 during the last two sampling rounds have been below the cleanup goal. Although EPHs in ZWM-99-22X remain above the cleanup goal (330 µg/L in October 2003), the values have decreased significantly from 2,500 µg/L since the initial sampling, and a linear trend analysis of the data suggests that the values will continue to decline (Appendix D, Graph D-5).

- EPH in sentry well ZWM-99-23X were initially at relatively low concentrations, but increased above the C11-C22 aromatics cleanup goal in two consecutive sampling events (October 2000 and May 2001). EPH results for this well fell back below the goal after May 2001 and have been below detection levels since October 2002.
- Sentry well ZWM-95-15X showed no EPH aromatics prior to May 2002 when a single detection of 1,400 µg/L was noted. Since that time, results for this well have been below detection levels.

Arsenic and Manganese

- Two source wells (69W-94-13 and ZWM-99-22X) and one sentry well (ZWM-99-23X) account for all on-going exceedances of the cleanup goal for arsenic. Results for sentry well ZWM-99-23X fell below the goal from May 2002 to May 2003; however in the October 2003 sampling round, the result was again above the goal. The arsenic detections in these three wells range from a minimum of 15 (ZWM-99-23X) to a maximum of 230 µg/L (ZWM-99-23X). The arsenic concentration in each of these wells varies somewhat over time, but appears to show no markedly increasing or decreasing trend.
- Two source wells (69W-94-13 and ZWM-99-22X) and two sentry wells (ZWM-95-15X and ZWM-99-23X) account for all on-going exceedances of the 375 µg/L cleanup goal for manganese. A third sentry well (ZWM-01-25X) exhibited a lone manganese exceedance in October 2002, but since that time has been below the cleanup goal.
- Manganese in the two source wells 69W-94-13 and ZWM-99-22X and sentry well ZWM-99-23X exceeded the 375-µg/L goal in all monitoring rounds to date. Results for sentry well ZWM-95-15X were below the goal in both 2001 sampling rounds but have been consistently above the goal since that time. Linear trend analyses of the manganese data for the two source wells and sentry well ZWM-95-15X suggest an increasing concentration trend, while concentrations in sentry well ZWM-99-23X appear to be decreasing.

In summary, all monitoring wells with the exception of ZWM-99-22X are attaining cleanup goals for EPH and VPH. EPH concentrations in well ZWM-99-22X exceed the EPH aromatic C11 – C19 goal, but have decreased substantially and continue to show a decreasing trend. Three monitoring wells, 69W-94-13, ZWM-9-22X, ZWM-99-23X, continue to exceed the 50 µg/L cleanup goal for arsenic with little apparent trend either up or down. However, the presence of arsenic in groundwater at AOC 69W is believed driven by reductive dissolution from overburden soils as a result of the aerobic biodegradation of fuel compounds. Monitoring data show the ongoing cleanup of fuel at AOC 69W, and arsenic concentrations are expected to decrease after fuel degradation is complete.

In addition, four monitoring wells continue to show exceedances of the manganese cleanup goal. These include the three wells that show arsenic exceedances (69W-94-13, ZWM-9-22X, ZWM-99-23X) plus well ZWM-01-25X. Monitoring well ZWM-01-25X exhibited a one time manganese cleanup goal exceedance in October 2002, but has been below the goal in the subsequent two sampling rounds. Similar to the case for arsenic, the presence of manganese in groundwater at AOC 69W is believed driven by reductive dissolution from overburden soils as a result of the aerobic biodegradation of fuel compounds. Monitoring data show the ongoing cleanup of fuel at AOC 69W, and manganese concentrations are expected to decrease after fuel degradation is complete.

The ten monitoring wells at AOC 69W are adequately distributed to detect changes in contaminant concentrations across this site. Since it is difficult to predict an exact timeframe for aquifer restoration at this time, it is prudent to continue the periodic monitoring and reporting process. There are provisions for the review committee to adjust the program in accordance with the ROD.

The monitoring program has been effective so far in meeting the objectives, monitoring potential off-site migration, detecting changes in the concentrations of the COCs, and protecting against exposures. The monitoring wells are adequately distributed, data acquisition and QA are performed competently, and periodic reviews occur as scheduled.

The Army evaluated the quality of performance data for each sampling and testing event. The field crews followed prescribed field QC procedures and checks. QA/QC samples were collected to monitor the sample collection, transportation, and analysis procedures. USACE staff chemists examined the primary laboratory's data for acceptability with respect to Data Quality Objectives and prepared QA reports from the results on QA samples. Findings are included in the annual reports.

All VPH and metals comparisons were in good overall and quantitative agreement. However, as reported in the 2001 Annual Report, questions arose in 2001 regarding EPH analyses (USACE, 2002). Comparisons of analytical result produced by the primary laboratory (AMRO Environmental Laboratories, Merrimack, NH) with those from the QA laboratory (Severn Trent Laboratory [STL], Colchester, VT) showed that the primary laboratory's results in past rounds were consistently higher than the QA laboratory's for the C11-C22 aromatic hydrocarbons. The primary laboratory performs the MADEP-EPH analyses using a modified method based on a gas chromatograph mass spectrometer (GC/MS) system. The QA laboratory performs the traditional GC flame ionization detector (GC/FID) methodology. The GC/MS method appears more sensitive than the GC/FID method in quantifying the hydrocarbon ranges, and, therefore, results may be biased high. Because the two laboratories performed the EPH analysis differently, USACE performed a comparability study that included comparisons of results from four laboratories, including the MADEP Wall Experiment Station, as described in the Annual Report for 2001. It was subsequently determined that each method was valid and acceptable. The Army

continues to utilize the primary laboratory's modified method to maintain consistency in this long-term monitoring program.

Institutional controls are ensuring that exposures to contaminated subsurface soils are controlled and that extraction of groundwater from beneath the site is not permitted. MassDevelopment provides potable municipal water. The Army's sampling team reports results of institutional control inspections in the semi-annual and annual reports.

4.2 REMEDY OBJECTIVES

The remedy objectives for each remedial component were established and accomplished. These objectives are presented in Table 5.

TABLE 5 - REMEDY OBJECTIVES AND RESULTS

Remedy Component Objectives	Results
Long-term monitoring	LTMP approved. Semiannual long-term monitoring continues; see results in Appendix D. Two monitoring wells added. LTMP to be revised as necessary by project team.
Institutional controls	USACE sampling team reports results in each semi-annual and annual report.
Five-year reviews	First review performed in September 2000.

4.3 INSPECTION AND CERTIFICATION

4.3.1 Inspections

The USACE sampling team inspects the monitoring wells and the physical features of AOC 69W during each round and states any significant observations in each annual report. No discrepancies or concerns have been noted.

4.3.2 Certification of Completion

The Army has provided documentation verifying the institutional control and long-term monitoring remedy components are established in the annual reports, and USEPA/MADEP has concurred.

The Army evaluates the quality of performance data for each sampling event and provides data quality evaluations in the annual reports. There are checks on field QC procedures, and chemists review the primary laboratory's data and evaluate QA sample results. All VPH and metals comparisons have been in good overall quantitative agreement to date. A discrepancy was detected between the primary and QA laboratories' EPH results because of different methodologies. The primary laboratory's method appears to be more sensitive and the resulting concentrations may be biased high. The methods were investigated and both were considered valid.

The Army's sampling team leader observes site conditions around the school during each semiannual event ensuring that the institutional controls are being met. Observations were included in the annual reports. No excavations were observed within the ESMA, confirming continued protection against exposure to remaining contaminated soils. MassDevelopment supplies potable water to the school. Existing land use is evaluated in the five-year review process to ensure institutional control requirements are being met. The current tenant is abiding by the institutional controls imposed on the property.

5.0 OPERATION AND MAINTENANCE ACTIVITIES

5.1 LONG-TERM MONITORING

Long-term monitoring of groundwater has been underway since May 2000. Eight rounds have been completed as of November 2003. Adjustments have been made to the program. As recommended in the First Five-Year Review Report (HLA, 2000b), iron was no longer considered a COC, but it continues to be analyzed, as it is an indicator of remediation efficacy.

In the May 2000 round, results for well ZWM-96-19X (boiler room) continued to be below the cleanup goals, and the well was dropped from further monitoring in accordance with the LTMP. Also, the SVOC bis(2-ethylhexyl)phthalate was analyzed for in wells ZWM-95-17X and ZWM-99-22X to assess if its detection in 1996 RI samples were site related or a sampling/laboratory artifact. It was not detected in either well or in duplicate ZWM-DUP-001. Therefore, it was dropped from future testing rounds.

Analytical data from the first three long-term monitoring rounds indicated that EPH aromatic hydrocarbons in the C11-C22 range, VPH aromatic hydrocarbons in the C9-C10 range, arsenic, and manganese were detected in sentry well ZWM-99-23X. Therefore, ZWM-99-23X no longer fits the definition of a sentry well, and two additional monitoring wells (ZWM-01-25X and ZWM-01-26X) were installed down and cross gradient of ZWM-99-23X in October 2001 (see Figure 3). Ten monitoring wells are now sampled semi-annually.

Based on the data comparability study reported in the 2001 Annual Report and discussed in Subsection 4.3, the Army continues to use the GC/MS method used by AMRO for MADEP analyses. Appendix D presents the numerical and graphic summary of analytical results including those from the October 2003 sampling round. Graphs D-1 through D-12 in Appendix D present linear data trends for data since May 2000.

As specified in the ROD, the purpose of monitoring is to confirm that the site continues to have no impact upon human health and the environment. The LTMP will be changed over time depending upon results. Changes will be noted in the LTMP and Five-year reviews.

5.2 Five-year Review Findings/Recommendations

Five-year reviews are performed to review the data collected and assess the effectiveness of the remedy. AOC 69W was described in the first Five-Year Review Report dated September 2000 (HLA, 2000b). At that time, only the first long-term monitoring sampling round had been completed and it was not reviewed. The major points in the Five-Year Review were:

- Applicable or relevant and appropriate requirements (ARARs) in the ROD were reviewed for changes that could affect protectiveness. None of the listed ARARs had been changed since the signing of the ROD.
- No areas of non-compliance were identified.

Addressing whether the remedy is functioning as intended, the assessment was:

- Health and safety procedures for the long-term groundwater monitoring in documents and plans are properly implemented.
- Implementation of institutional controls is satisfactory.
- Transfer of the property is pending the Land Use Plan Memorandum of Agreement and so institutional controls have not been officially implemented into the deed. No violations are known.
- Groundwater monitoring is conforming to the approved LTMP.
- Iron is no longer considered a COC and the Five-Year Review recommended removal of iron as a monitored contaminant. In addition, it recommended that groundwater monitoring be discontinued if four consecutive representative samples are below action criteria.
- There were no early indicators of potential remedy failure evident during this review.

Addressing the question whether the assumptions used at the time of the remedy are still valid, the following points were made:

- With exception of arsenic, the review identified no changes to existing ARARs or newly promulgated standards or regulations affecting the remedy.
- There were no changes in exposure pathways.
- There were no changes in toxicity and other contaminant characteristics.
- Based on USEPA's risk guidance, non-cancer health risks would not be calculated for iron and iron would not be identified as a COC.

The Five-Year Review concluded that the selected remedy was protective and was expected to remain protective of human health and the environment.

6.0 PROJECT COSTS

Cost estimates in the ROD for the Limited Action Alternative are:

- Estimated capital costs: $23,300
- Estimated operation and maintenance costs: $172,000
- Estimated Total Costs: $195,300

There is no specified period of performance or breakout for that total. Total project O&M costs to date are about $155,000, including the two new monitoring wells installed in October 2001.

7.0 OBSERVATIONS AND LESSONS LEARNED

The long-term monitoring program was initiated in May 2000. Observations and lessons learned through this process are as follows.

- Iron was dropped as a COC, but it continues to be analyzed as an indicator of remediation efficacy.
- In the May 2000 round, results for well ZWM-96-19X (boiler room) continued to be below the cleanup goals, and the well was dropped from further monitoring in accordance with the LTMP.
- The SVOC bis(2-ethylhexyl) phthalate was analyzed for in wells ZWM-95-17X and ZWM-99-22X to assess if its detection in 1996 RI samples was site related or a sampling/laboratory artifact. It was not detected in either well or in duplicate ZWM-DUP-001. Therefore, this compound was dropped from future testing rounds.
- There were discrepancies in EPH results for field samples analyzed by AMRO and corresponding QA results from STL. AMRO's results for the C11-C22 aromatic hydrocarbons were consistently higher than the QA lab's results. AMRO performs the MADEP-EPH analyses using a modified method based on a GC/MS system. STL performs the traditional GC/FID methodology. A comparability study against AMRO's method was performed using four laboratories. Method complexities make it difficult to ascertain which analytical method best represents true EPH concentrations. The Army will continue to utilize AMRO's analytical results to maintain consistency in this long-term monitoring program.
- On January 22, 2001, USEPA adopted a revised drinking water standard for arsenic (formerly 50 µg/L), and public water systems must comply with the 10 µg/L standard beginning January 23, 2006.
- Analytical data from well ZWM-99-23X showed it no longer fits the definition of a sentry well, and two new monitoring wells (ZWM-01-25X and ZWM-01-26X) were installed down- and cross-gradient of ZWM-99-23X in October 2001.
- Results from May 2000 through October 2003 show that the following five wells have not exceeded cleanup goals for any of the COCs: background well ZWM-95-17X, source well 96W-94-14, sentry wells ZWM-95-18X and ZWM-99-24X, and new sentry well ZWM-01-26X. A third sentry well (ZWM-01-25X) exhibited a lone manganese exceedance in October 2002, but since that time has been below the cleanup goal.
- Results show certain wells exceed the cleanup goals for the following COCs: EPH in the C11-C22 aromatic range (200 µg/L), arsenic (50 µg/L), and manganese (375 µg/L), as described below.

- EPH concentrations in well ZWM-99-22X exceed the EPH aromatic C11 – C19 goal, but have decreased substantially and continue to show a decreasing trend.

- Three monitoring wells, 69W-94-13, ZWM-9-22X, ZWM-99-23X, continue to exceed the 50 µg/L cleanup goal for arsenic with little apparent trend either up or down. However, the presence of arsenic in groundwater at AOC 69W is believed driven by reductive dissolution from overburden soils as a result of the aerobic biodegradation of fuel compounds. Monitoring data show the ongoing cleanup of fuel at AOC 69W, and arsenic concentrations are expected to decrease after fuel degradation is complete.

- Four monitoring wells continue to show exceedances of the manganese cleanup goal. These include the three wells that show arsenic exceedances (69W-94-13, ZWM-9-22X, ZWM-99-23X) plus well ZWM-01-25X. Monitoring well ZWM-01-25X exhibited a one time manganese cleanup goal exceedance in October 2002, but has been below the goal in the subsequent two sampling rounds. Similar to the case for arsenic, the presence of manganese in groundwater at AOC 69W is believed driven by reductive dissolution from overburden soils as a result of the aerobic biodegradation of fuel compounds. Monitoring data show the ongoing cleanup of fuel at AOC 69W, and manganese concentrations are expected to decrease after fuel degradation is complete.

8.0 CONTACT INFORMATION

No remedial construction is being performed. USACE staff perform long-term monitoring sampling. Technical Drilling Services of Sterling, Massachusetts installed the two new monitoring wells in October 2001.

The following companies analyzed samples:

Primary laboratory:
AMRO Environmental Laboratories, Inc.
111 Herrick Street
Merrimack, NH 03054

QA laboratory:
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Appendix A

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Appendix A

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U.S. Environmental Protection Agency (USEPA), OSWER Directive 9320.2-09A. *"Close Out Procedures for National Priorities List Sites"*, January 3, 2000.

Appendix B

Glossary of Acronyms and Abbreviations

Appendix B

Glossary of Acronyms and Abbreviations

AOC	Area of Contamination
ARAR	Applicable or Relevant and Appropriate Requirement
AREE	Area Requiring Environmental Evaluation
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
cPAH	carcinogenic polynuclear aromatic hydrocarbons
EPH	extractable petroleum hydrocarbons
ESMA	excavated soil management area
FID	flame ionization detector
GC	gas chromatograph
LTMP	Long-term Monitoring Plan
MADEP	Massachusetts Department of Environmental Protection
MS	mass spectrophotometer
MCP	Massachusetts Contingency Plan
µg/L	micrograms per liter
NDIR	non-dispersive infrared detection
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RFTA	Reserved Forces Training Area
SI	Site Investigation
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons

USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons

Appendix C

Monitoring Wells Used for Long-term Monitoring

Appendix D

Historical Groundwater Analytical Data Summary (2000-2003)

Figures