Fort Devens, Massachusetts

Proposed Plan

Shepley's Hill Landfill
AOCs 4, 5, & 18

May 1995

Army Proposes Cleanup Plan for Shepley's Hill Landfill Operable Unit

The Army, in coordination with the U.S. Environmental Protection Agency (USEPA), is proposing a **cleanup** plan, referred to as a preferred alternative, to address groundwater contamination at the Shepley's Hill Landfill at Fort Devens, Massachusetts. The proposed cleanup focuses on **groundwater** that has been contaminated by **organic** and **inorganic chemicals** released by Shepley's Hill Landfill. This proposed plan combines cleanup options recommended from among those that were evaluated during the **Remedial Investigation** (RI), Supplemental RI, and **Feasibility Study** (FS) performed for the site. In accordance with Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA), the Army is publishing this proposed plan to provide an opportunity for public review and comment on the cleanup alternatives, known as **remedial alternatives**, under consideration for the site. The selection of a preferred alternative is not a final decision. The Army will consider public comments as part of the final decision-making process for selecting the cleanup remedy for the site.

The Army's preferred alternative is to complete the closure of Shepley's Hill Landfill in accordance with Massachusetts requirements, and to monitor and evaluate the effectiveness of the recently installed landfill cover system at controlling groundwater contamination and site risk. The preferred alternative consists of multiple components to control the release of contaminants from wastes buried in the Shepley's Hill Landfill to the groundwater and to reduce the potential risk of future residential exposure to contaminated groundwater. The following components make up the preferred alternative: (1) survey of Shepley's Hill Landfill; (2) evaluation/improvement of

Note: Words that appear in bold in this document are defined in the glossary.

stormwater diversion and drainage; (3) landfill cover maintenance; (4) landfill gas collection system maintenance; (5) long-term groundwater monitoring; (6) long-term landfill gas monitoring; (7) **institutional controls**; (8) educational programs; (9) design of a contingency groundwater extraction system; (10) annual reporting to the Massachusetts Department of Environmental Protection (MADEP) and USEPA; and (11) five-year site reviews. The preferred alternative is described in greater detail on pages 16 through 21 of this document.

As described later in this proposed plan, the Army believes the preferred alternative is the most practical approach for protecting human health and the environment at Shepley's Hill Landfill **Operable Unit**. The long-term monitoring, reporting, and review components of the preferred alternative will enable an evaluation of its effectiveness and that of the Shepley's Hill Landfill cover system at protecting human health and the environment. Acceptance of this proposed plan will result in issuance of a final **record of decision** to document the decision.

If five-year site reviews indicate that cleanup progress is not proceeding according to criteria, the Army will evaluate whether additional remedial actions are appropriate. Because groundwater extraction and discharge to the Town of Ayer wastewater treatment facility or publicly owned treatment works (POTW) is already approved by USEPA and MADEP, the Army, as a contingency measure, will conduct the necessary pre-design studies and prepare a 60 percent complete engineering design for groundwater extraction and discharge as part of the preferred alternative. This will facilitate the timely implementation of groundwater extraction if the decision is made to proceed with it at a future date. Other alternatives may be considered by the Army subject to review and approval by USEPA and MADEP. Implementation of the preferred plan is consistent with the potential extraction and discharge of groundwater, because the landfill cover system is anticipated to reduce the volume of, and level of contamination in, groundwater.

This proposed plan:

- explains the opportunities for the public to comment on the remedial alternatives;
- includes a brief history of the site and the principal findings of site investigations;
- provides a brief description of the preferred alternative and other alternatives evaluated during the FS;

- outlines the criteria used by the Army to propose an alternative for use at the site and briefly analyzes whether the alternatives meet each criteria; and

- presents the Army's rationale for its preliminary selection of the preferred alternative.

To help the public participate in reviewing the cleanup options for the site, this document also includes information about where interested citizens can find more detailed descriptions of the remedy process and the alternatives under consideration for the Shepley's Hill Landfill Operable Unit at Fort Devens.

The Public's Role in Evaluating Remedial Alternatives

Public Informational Meeting

The Army will hold a public informational meeting on Tuesday, June 6, 1995 at 7:00 p.m. at the Fort Devens Community Activity Center to describe the preferred alternative and other alternatives evaluated in the FS report. The public is encouraged to attend the meeting to hear the presentation and to ask questions.

Public Comment Period

The Army is conducting a 30-day comment period from June 1, 1995 to June 30, 1995 to provide an opportunity for public involvement in the cleanup decision. During the comment period, the public is invited to review this proposed plan, the RI report, RI Addendum report, and the FS report, and to offer comments to the Army. These documents are available at the public information repositories at the libraries in the towns of Ayer, Shirley, Lancaster, and Harvard, and at the Fort Devens Base Realignment and Closure (BRAC) Environmental Office.

Public Hearing

The Army will hold an informal public hearing on this proposed plan on Tuesday, June 27, 1995 at 7:00 p.m. at the Fort Devens Community Activity Center, followed by an informal question and answer period. During the public hearing, the public can provide oral or written comments on the proposed cleanup plan. Comments made at the hearing will be transcribed. A copy of the transcript will be added to the Fort Devens Administrative Record. The Administrative Record contains documents used by the Army to choose a remedy for the site, and is made available to the public at the information repository locations listed on pages 4 and 5.

Written Comments

If, after reviewing the information on the site, you would like to comment in writing on the Army's preferred alternative, any of the other cleanup alternatives under consideration, or other issues relevant to the cleanup, please deliver your comments to the Army at the Public Hearing, or mail your written comments (postmarked no later than June 30, 1995) to:

Jim Chambers
BRAC Environmental Coordinator
AFZD-BEC
P.O. Box 1
Fort Devens, MA 01433-5010

Army's Review of Public Comment

The Army will review comments received from the public as part of the process of reaching a decision on the most appropriate remedial alternative, or combination of alternatives, for addressing groundwater contamination at the Shepley's Hill Landfill. The Army will issue its choice of a remedy in a record of decision for the site in September 1995. A responsiveness summary that summarizes the Army's responses to comments received during the public comment period, will be issued with the record of decision. Once the record of decision is signed by the Chief of Staff, FORSCOM, the Fort Devens BRAC Environmental Coordinator, and the USEPA Regional Administrator for New England, it will become part of the Administrative Record.

Additional Public Information

Because this proposed plan provides only a summary description of the investigation of the site and the cleanup alternatives considered, the public is encouraged to consult the Administrative Record, which contains the RI, RI Addendum, and FS reports, and other site documents, for a more detailed explanation of the site and all of the remedial alternatives under consideration. The Administrative Record is available at the following locations:

BRAC Environmental Office
Building P-12, Buena Vista Street
Fort Devens, MA 01433-5010
(508) 796-3114 ext. 311 (Jim Chambers)
Hours: Monday-Friday: 9:00 a.m. - 4:00 p.m.

Ayer Town Hall
Main Street
Ayer, MA 01432
(508) 772-8220 (Tim Higgins)
Hours: Monday-Friday: 9:00 a.m. - 4:00 p.m.

Site History

The Shepley's Hill Landfill includes three **Areas of Contamination** (AOCs): AOC 4, the sanitary landfill incinerator; AOC 5, sanitary landfill No. 1 or Shepley's Hill Landfill; and AOC 18, the asbestos cell. AOCs 5 and 18 are located within the **capped** area at Shepley's Hill Landfill. The three AOCs are collectively referred to as Shepley's Hill Landfill in this proposed plan.

Shepley's Hill Landfill encompasses approximately 84 acres in the northeast corner of the Main Post at Fort Devens (Figure 1). It is situated between the bedrock outcrop of Shepley's Hill on the west and Plow Shop Pond on the east (Figure 2). Nonacoicus Brook, which drains Plow Shop Pond, flows through a wooded wetland at the north end of the landfill. The southern end of the landfill borders the Defense Reutilization and Marketing Office (DRMO) yard and a warehouse area. An area east of the landfill and south of Plow Shop Pond is the site of a former railroad roundhouse.

Review of the surficial geology map of the Ayer Quadrangle shows that in the early 1940s the active portion of the landfill consisted of approximately 5 acres near the end of Cook Street, near where **monitoring well** SHL-1 is located. The fill was elongated north-south along a pre-existing small valley marked by at least two swamps (probably kettle holes) and lying between the bedrock outcrop of Shepley's Hill to the west and a flat-topped kame terrace to the east with an elevation of approximately 250 feet, adjacent to Plow Shop Pond. During the landfilling operation, the valley was filled-in, and much of the kame terrace, which may have been used as cover material, disappeared. Background information indicates the landfill once operated as an open burning site.

Landfill operations at Shepley's Hill Landfill began at least as early as 1917 and stopped as of July 1, 1992. During its last few years of use, the landfill received about 6,500 tons per year of household refuse and construction debris, and operated using the modified trench method. There is evidence that trenches in the northwest portion cut into previously used areas containing glass and spent shell casings. The glass dated from the mid-nineteenth century to as late as the 1920s. The approximate elevation of the bottom of the waste is estimated at 220 feet above sea level at the north end of the landfill, and 225 feet above sea level in the central and southeast portions of the landfill,

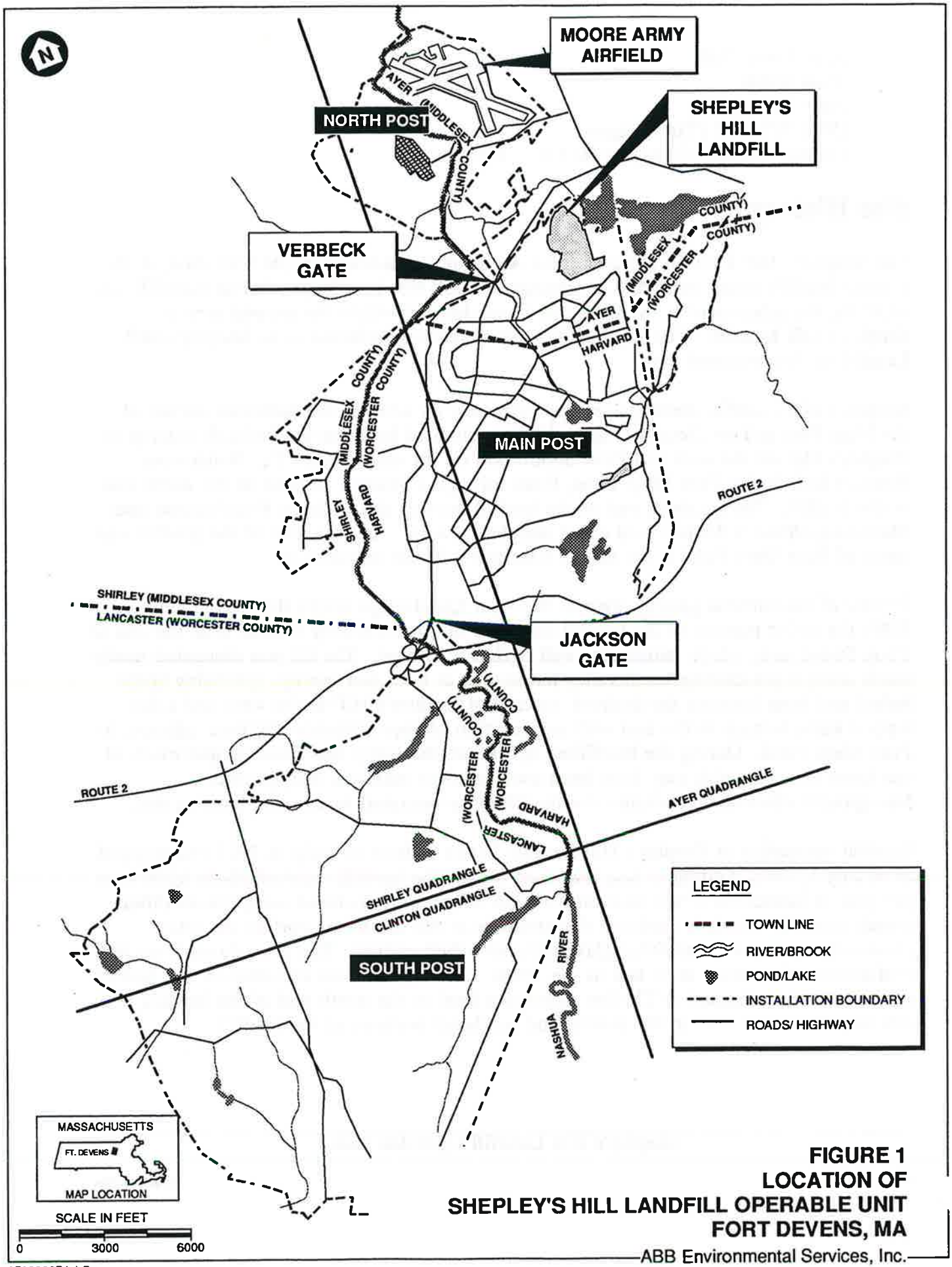

FIGURE 1
LOCATION OF
SHEPLEY'S HILL LANDFILL OPERABLE UNIT
FORT DEVENS, MA

ABB Environmental Services, Inc.

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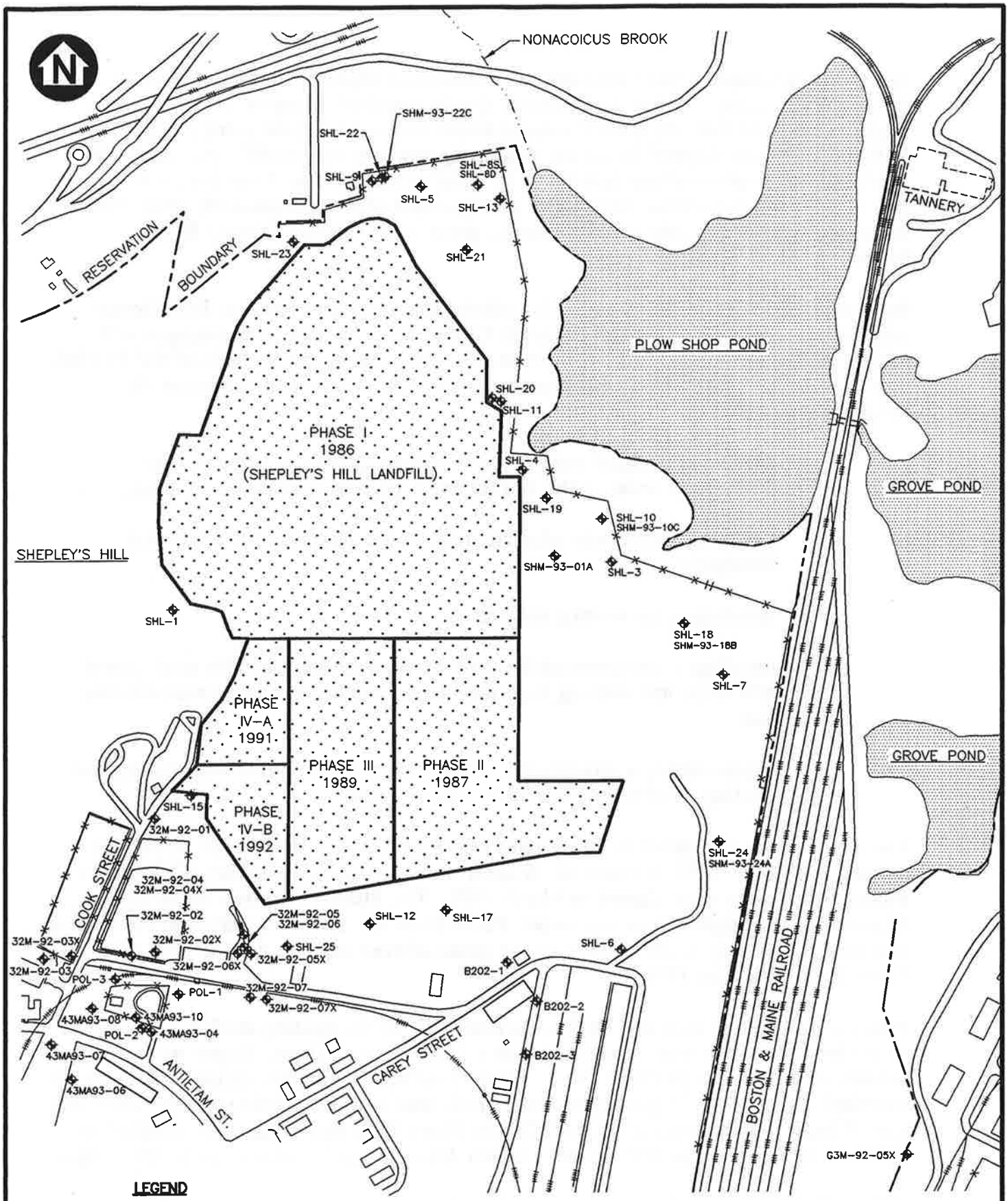

FIGURE 2
SHEPLEY'S HILL LANDFILL SITE MAP
FORT DEVENS, MA
ABB Environmental Services, Inc.

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based on pre-landfill surface contours. The maximum depth of the refuse is about 30 feet. The average thickness of waste is not documented; however, if the average thickness were 10 feet, the landfill volume would be over 1,300,000 cubic yards. Reports of flammable fluid disposal in the southeastern portion of the landfill have not been substantiated by observations in test pits or other research. The Army has no evidence that hazardous wastes were disposed of in the landfill after November 19, 1980. No waste **hot spots** or hazardous waste disposal areas were identified during RI or Supplemental RI activities.

In an effort to mitigate the potential for off-site contaminant migration, Fort Devens initiated the Fort Devens Sanitary Landfill Closure Plan in 1984, in accordance with Massachusetts regulations 310 CMR 19.00. The plan was approved by MADEP in 1985. The closure plan approval was consistent with 310 CMR 19.00 and contained the following requirements:

- grading the landfill surface to a minimum 2 percent slope in non-operational areas of the landfill and 3 percent in operational areas;
- removing waste from selected areas within 100 feet of the 100-year floodplain;
- installing a gas venting system;
- installing a low permeability cap and covering the cap with sand, gravel, and loam, and seeding to provide cover vegetation and prevent erosion; and
- implementing a groundwater monitoring program based on sampling five existing monitoring wells every four months.

The capping was completed in four phases (see Figure 2). In Phase I, 50 acres were capped in October 1986; in Phase II, 15 acres were capped in November 1987; and in Phase III, 9.2 acres were capped in March 1989. The Phase IV closure of the last 10 acres was accomplished in two steps: Phase IV-A was closed in 1991, and Phase IV-B was closed as of July 1, 1992, although the **geomembrane** cap was not installed over Phase IV-B until May 1993.

Because of the large area and shallow surface slope of the existing landfill, early phases of the landfill closure were completed with a 2 or 3 percent slope. Slopes were increased to 5 percent in Phase IV-B. Phases I through IV-A were capped with a 30-mil polyvinyl chloride (PVC) geomembrane overlain with a 12-inch drainage layer and 6-inch topsoil layer. At the request of MADEP, the Phase IV-B cap design was modified to include a 40-mil PVC geomembrane, a 6-inch drainage layer, and a 12-inch topsoil layer.

A landfill gas collection system consisting of 3-inch diameter gas-collection pipes bedded in a minimum 6-inch thick gas-venting layer was installed beneath the PVC geomembrane in all closure phases. Gas vents were installed through the PVC geomembrane at 400-foot centers. A minimum 6-inch cushion/protection layer was maintained between the geomembrane and underlying waste. As requested by USEPA and MADEP, four additional groundwater monitoring wells were installed in 1986 to supplement the five in the original groundwater monitoring program. The Army is presently assembling pertinent information for submittal to MADEP pursuant to 310 CMR 19.000 to document that Shepley's Hill Landfill was closed in accordance with plans and applicable MADEP requirements. The landfill will be closed pursuant to 310 CMR 19.000 prior to the September 1995 signing of the record of decision.

AOC 4, the sanitary landfill incinerator was located in former Building 38 near the end of Cook Street within the area included in Phase I of the sanitary landfill closure. The incinerator was constructed in 1941, burned household refuse, and operated until the late 1940s. Ash from the incinerator was buried in the landfill. The incinerator was demolished and buried in the landfill in September 1967. The building foundation was removed and buried on-site in 1976.

AOC 18, the asbestos cell, is located in the section of the landfill closed during Phase IV. Between March 1982 and November 1985, an estimated 6.6 tons of asbestos construction debris were placed in the section of the landfill closed during Phase IV-A. A new asbestos cell was opened in 1990 in the section closed during Phase IV-B, and was used until July 1992 for disposal of small volumes of asbestos-containing material.

Results of the Field Investigations

The RI at Shepley's Hill Landfill began in 1991. Additionally, during preparation of the FS report, data gaps were identified and Supplemental RI sampling began in 1992. The RI, RI Addendum, and FS reports present the findings of the investigations and contain a summary of the investigations that were performed. The public is encouraged to review these documents.

Soils. The RI at Shepley's Hill Landfill included collecting three surface soil samples from suspected seep areas and analyzing them for Target Compound List (TCL) organic compounds, Target Analyte List (TAL) metals, and total organic carbon (TOC). Low concentrations of acetone and methylene chloride were reported in the samples; however, they were attributed to laboratory contamination. No other organics were detected. Concentrations of TAL metals were within the estimated **background** range, except for calcium, which was elevated slightly. This was not considered significant. Because soil contamination was not identified during the RI, soils were not sampled during the Supplemental RI.

Groundwater. Assessment of groundwater quality included two rounds of sampling at 22 monitoring wells during the RI, and one confirming round of sampling at 27 monitoring wells plus a second round at five monitoring wells during the Supplemental RI. Target analyte groups for the RI and Supplemental RI field programs included **volatile organic compounds** (VOCs), **semivolatile organic compounds** (SVOCs), pesticides, **polychlorinated biphenyls** (PCBs), explosives, and inorganics.

The RI report concluded that groundwater **downgradient** of the landfill was contaminated with VOCs and inorganics as well as low concentrations of explosives, pesticides, and PCBs in scattered monitoring wells. The presence of pesticides was not certain, however, because of apparent laboratory contamination of several method blanks. The PCB Aroclor-1260 was reported at a low concentration in only one of 22 samples in one sampling round. The SVOC di-ethylphthalate was reported at 12 and 32 **parts per billion** (ppb) in samples from two separate monitoring wells, and was considered a sampling artifact.

The RI Addendum report also concluded that downgradient monitoring wells were contaminated with several VOCs and inorganics. A total of nine VOCs was reported at low concentrations in seven of the monitoring wells. Organic compounds were reported most frequently and at the highest concentrations in the downgradient monitoring wells SHL-11, SHL-19, SHL-20, and SHM-93-10C along the eastern edge of the landfill. In two instances, concentrations exceeded federal **Maximum Contaminant Levels** (MCLs) or Massachusetts Maximum Contaminant Levels (MMCLs) for drinking water: total dichlorobenzenes were reported at 11 ppb (the MMCL for 1,4-dichlorobenzene = 5 ppb) in monitoring well SHL-20, and the VOC 1,2-dichloroethane was reported at 9.9 ppb (MCL = 5 ppb) in monitoring well SHM-93-10C.

Inorganics were also reported at the highest concentrations in downgradient monitoring wells, especially SHL-10, SHL-11, SHL-19, SHL-20, and SHM-93-22C. Unfiltered groundwater samples from downgradient monitoring wells typically exceeded background concentrations for arsenic, calcium, iron, magnesium, manganese, and potassium. In addition, there were scattered exceedances of background concentrations for barium, lead, vanadium, and zinc. The concentrations of arsenic ranged from 69 to 390 ppb (MCL = 50 ppb) in unfiltered samples from these monitoring wells. A significant portion of the total concentration of the inorganics was often associated with suspended material in the samples. An exception to this was the presence of dissolved arsenic in monitoring wells SHL-11, SHL-19, and SHL-20, all of which had high concentrations of arsenic in both filtered and unfiltered samples. Low oxidation potential in the samples with high dissolved arsenic concentrations was consistent with expected conditions downgradient of the landfill.

No pesticides or PCBs were reported in the Supplemental RI groundwater samples. This led the RI Addendum report to reinterpret groundwater data presented in the RI report.

Although pesticides were reported at low concentrations in several RI samples, no monitoring well had pesticides detected in both RI sampling rounds. In addition, the RI report states that several pesticides including heptachlor, endrin, alpha- and beta-benzenehexachloride (BHC), 2,2-bis(para-chlorophenyl)-1,1,1-trichloroethane (DDT), and endosulfan sulfate were detected in method blank samples and that low concentrations of those compounds should be considered laboratory contamination. The RI report also noted difficulties with the pesticide and PCB analyses. These considerations and the Supplemental RI data support the conclusion that the landfill is not a source of pesticides or PCBs in groundwater.

Supplemental RI data included the reported presence of the explosive nitroglycerine in one monitoring well, the water table monitoring well SHM-93-24A, at 80.8 ppb. This monitoring well is considered cross-gradient of the landfill and the source of the nitroglycerine is not known. The landfill is not considered a source of nitroglycerine. Although the explosives 1,3,5-trinitrobenzene, 1,3-dinitrobenzene and tetryl were reported inconsistently and at low concentrations in RI samples, they were not detected in the Supplemental RI samples. SVOCs were not identified as groundwater contaminants in the RI report or targeted as analytes during the Supplemental RI field program. They are not considered groundwater contaminants at Shepley's Hill Landfill.

Plow Shop Pond Sediments. Plow Shop Pond is believed to have been an historical discharge area for groundwater passing beneath Shepley's Hill Landfill and to have received contamination from the landfill. The characterization of Plow Shop Pond **sediments** was accomplished during both the RI and Supplemental RI. The RI report concluded that pond sediments were contaminated with high concentrations of TAL metals and low concentrations of several **polynuclear aromatic hydrocarbons** (PAHs). The VOCs acetone, methylene chloride, and 2-butanone were reported in several samples, as were low concentrations of 2,2-bis(para-chlorophenyl)-1,1-dichloroethene (DDE) and heptachlor. The presence of acetone, methylene chloride, and heptachlor is attributed to laboratory contamination.

Additional sediment samples were collected during the Supplemental RI. The RI Addendum report concluded that sediments were contaminated with arsenic, barium, copper, chromium, iron, lead, manganese, mercury, nickel, and zinc. Based on manufacturing process chemicals, waste disposal practices, and chemical distribution patterns in Plow Shop and Grove ponds, a former tannery located on Grove Pond was identified as the major source of arsenic, chromium, lead, and mercury. Shepley's Hill Landfill was identified as a primary source of barium, iron, manganese, and nickel and a secondary source of arsenic, chromium, and lead. Data were insufficient to define the source of copper. The Supplemental RI sampling confirmed the presence of 2,2-bis(para-chlorophenyl)-1,1-dichloroethane (DDD), DDE, and DDT at low concentrations in pond sediments. Several chemicals exceeded sediment quality guidelines. The RI Addendum report did not identify the landfill as a source of the

pesticides. Potential remedial actions for Plow Shop Pond sediment contamination will be evaluated in a separate engineering report for the Plow Shop Pond Operable Unit anticipated to be issued September 1, 1996. Environmental monitoring to assess any continuing effect of the landfill on the pond will take place as part of the Plow Shop Pond Operable Unit.

Surface Water. During the RI, samples were collected from 13 locations along the Plow Shop Pond shoreline to characterize **surface water** quality. Target analytes included TCL organics and TAL metals. The VOCs chloroform and methylene chloride were reported in several samples, and the pesticide endrin was reported at a low concentration in one sample. Methylene chloride was considered a laboratory contaminant and the detection of endrin was not considered significant in the RI report. The presence of chloroform, considered an improbable surface water contaminant in the RI report, could not be explained. The inorganics copper, silver, and zinc exceeded **Ambient Water Quality Criteria** (AWQC) for the protection of aquatic life throughout the pond, and iron and zinc exceeded AWQC in the wetlands area north of the pond.

Summary of Risks

The **risk assessment** contained in the RI Addendum report evaluates actual and potential risks associated with exposure to contaminated media at the site and updates the risk assessment of the RI report. Estimates of human health risk are compared to the Superfund target risk range for known or suspected cancer causing chemicals of $1x10^{-6}$ to $1x10^{-4}$ and to noncancer Hazard Index (HI) values of 1. Estimates of risk to ecological receptors are also compared to HI values of 1. Risks to human health were evaluated for the following media and exposure scenarios:

- incidental ingestion of Plow Shop Pond surface water, and long-term consumption of Plow Shop Pond fish by recreational fishermen and their families
- contact (dermal contact and incidental ingestion) with Plow Shop Pond sediment by site visitors
- contact (dermal contact and incidental ingestion) with surface water by swimmers in Plow Shop Pond
- future residential use of groundwater (there is no current identified use)

The ecological risk assessment evaluates risks to aquatic and semi-aquatic receptors from exposure to Plow Shop Pond surface water and sediments. Exposure of ecological receptors to groundwater was not evaluated because this was not considered a likely or

significant exposure pathway. Because the RI report did not identify human health or ecological risks for soils exceeding the target risk values, soils were not re-evaluated in the RI Addendum report.

The updated human health risk assessment identifies the following potential human health risks:

- Future residential use of unfiltered groundwater interpreted to be under the influence of the landfill and contaminated with several inorganics (arsenic, manganese, chromium, lead, nickel, and sodium) and 1,2-dichloroethane and dichlorobenzenes was estimated to present potential cancer risks of $4x10^{-4}$ to $8x10^{-3}$. Most of the risk was due to the presence of arsenic. If a downward modifying factor of 10 is applied to this estimate to account for the uncertainty associated with arsenic risks, the modified risk estimate is $4x10^{-5}$ to $8x10^{-4}$, still within or exceeding the Superfund target risk range. Manganese presented average and maximum noncancer HI values of 12 to 55.

  It should be noted that when present at the federal MCL for drinking water, arsenic presents an estimated cancer risk of $1x10^{-3}$, which exceeds the target risk range, and an HI of 5.

- Long-term consumption of fish from Plow Shop Pond presented cancer risks that ranged from $3x10^{-6}$ to $4x10^{-4}$, within or exceeding the Superfund target risk range. Arsenic accounted for approximately 96 to 99 percent of the risk, while DDE contributed approximately 4 to 0.4 percent. Mercury presented noncancer risks that exceeded the target value of 1 (HIs ranged from 2 to 7). If a downward modifying factor of 10 is applied to the cancer risk estimate to account for the uncertainty associated with arsenic risks, the modified risk estimate is $3x10^{-7}$ to $4x10^{-5}$, which is within or below the Superfund target risk range. Thus it appears that the major human health risk associated with Plow Shop Pond fish is due to mercury contamination.

- Long-term contact with Plow Shop Pond sediment presented cancer risks of $2x10^{-5}$ to $2x10^{-4}$ and $9x10^{-5}$ to $6x10^{-4}$ under current and future exposure scenarios, respectively. Only under the maximum exposure assumptions did the estimates exceed the target risk range. Arsenic was responsible for essentially 100 percent of the risk. If a downward modifying factor of 10 is applied to the cancer risk estimate to account for the uncertainty associated with arsenic risks, the modified risk estimates are $2x10^{-6}$ to $2x10^{5}$ (current exposure scenario) and $9x10^{-6}$ to $6x10^{-5}$ (future exposure scenario), which are within or below the Superfund target risk range.

The ecological risk assessment predicted, based on comparison to reference criteria, that Plow Shop Pond surface water and sediments present potential adverse risks to aquatic receptors. Average and maximum HI values for aquatic receptor exposure to surface water were 7.7 and 12.8, respectively. Primary contributors to potential risk were copper, silver, and zinc. For aquatic receptor exposure to sediments, average and maximum HI values were 182 and 1,300, respectively. Primary contributors to estimated risk were arsenic, chromium, manganese, and mercury. Other data, including fish and macroinvertebrate community studies, suggest that adverse effects may be less severe than predicted by the risk assessment.

For semi-aquatic wildlife and both average and maximum exposure scenarios, HIs were greater than 1 for five of the eight receptor species evaluated, including the mallard duck, painted turtle, green frog, mink, and muskrat. For the great blue heron, the HI for the maximum exposure scenario but not the average exposure scenario exceeded 1. HIs for the osprey and raccoon were well below 1. Sediments were predicted most likely to present potential risks to species with small home ranges and direct contact with sediment, such as the green frog or painted turtle. Primary contributors to predicted risk were arsenic, chromium, manganese, and mercury.

Actual or potential releases of hazardous substances from Shepley's Hill Landfill, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to public health, welfare, or the environment.

Proposed Cleanup Objectives and Levels

Using information gathered during the RI and Supplemental RI, the FS identified remedial response objectives for clean-up of groundwater and reduction of potential human health and ecological risk at the Shepley's Hill Landfill Operable Unit. In addition, the cleanup of groundwater at the Shepley's Hill Landfill Operable Unit will help control contamination to, and reduce risk in, Plow Shop Pond. Additional actions to manage risk from exposure to Plow Shop Pond surface water and sediment will be evaluated separately in a Plow Shop Pond Operable Unit engineering report anticipated to be issued September 1, 1996. Response objectives are site-specific, qualitative cleanup objectives based on the nature and extent of contamination, the resources currently or potentially threatened, and the potential for human and environmental exposure. Response objectives are used to develop remedial action objectives and appropriate remedial alternatives. The FS report identifies the following response objectives for the Shepley's Hill Landfill Operable Unit:

- Protect potential residential receptors from exposure to contaminated groundwater migrating from the landfill having chemicals in excess of MCLs.

- Prevent contaminated groundwater from contributing to the contamination of Plow Shop Pond sediments in excess of human health and ecological risk-based concentrations.

Response objectives were not identified for surface soil, landfill gas, or leachate. The risk assessments did not identify potential risks from exposure to surface soil, and ambient air monitoring during the RI did not identify airborne contaminants. Liquid leachate was not identified during either RI or Supplemental RI activities.

Remedial action objectives are medium- or operable unit-specific quantitative goals defining the extent of cleanup required to achieve response objectives. They specify contaminants of concern, exposure routes, and receptors. The remedial action objectives for the Shepley's Hill Landfill Operable Unit contain **Preliminary Remediation Goals** (PRGs) equal to MCLs for dichlorobenzenes, 1,2-dichloroethane, arsenic, chromium, and nickel. The PRG for lead is equal to the federal drinking water action level. The following remedial action objectives, established by the Army in cooperation with USEPA and MADEP, will be protective of public health and the environment:

- Prevent potential residential exposure to groundwater containing chemicals in excess of the following site-specific PRGs: 1,4-dichlorobenzene (5 ppb), 1,2-dichlorobenzene (600 ppb), 1,2-dichloroethane (5 ppb), aluminum (6,870 ppb), arsenic (50 ppb), chromium (100 ppb), iron (9,100 ppb), lead (15 ppb), manganese (291 ppb), nickel (100 ppb), and sodium (20,000 ppb).

- Prevent off-site migration of groundwater containing chemicals in excess of the above concentrations.

- Prevent contaminated groundwater from contributing to arsenic contamination of Plow Shop Pond sediments in excess of health- and risk-based concentrations.

- Meet location-specific and action-specific **Applicable or Relevant and Appropriate Requirements (ARARs)**.

The candidate remedial alternatives for the Shepley's Hill Landfill Operable Unit were evaluated for their potential to attain remedial action objectives and PRGs. The remedial alternative selected for the Shepley's Hill Landfill Operable Unit will be designed to achieve the above remedial action objectives.

Attainment of PRGs in groundwater will result in an approximate eight-fold reduction in potential human health risk, reflecting the approximate eight-fold reduction in arsenic concentrations needed to attain the arsenic PRG. The residual human health risk from residential exposure to groundwater after attainment of PRGs is estimated to be

approximately $1x10^{-3}$ (unmodified to account for the uncertainty associated with arsenic) and $1x10^{-4}$ if modified to account for the uncertainty associated with exposure to arsenic.

The Army's Preferred Alternative

The Army's selection of the preferred cleanup alternative for the Shepley's Hill Landfill Operable Unit at Fort Devens, as described in this proposed plan, is the result of a comprehensive screening and evaluation process presented in the FS report. The FS report identifies and analyzes alternatives for addressing groundwater contamination at the site. The FS report describes the considered alternatives, as well as the process and criteria the Army used to narrow the list to five potential alternatives. (For details on the Army's screening and evaluation methodology, see Sections 3, 4, and 5 of the FS report.) The following paragraphs describe the preferred alternative and the other alternatives that the Army retained for detailed analysis. The Army's preferred alternative is Alternative SHL-2: Limited Action with Alternative SHL-9 as a potential contingency action. The components of Alternative SHL-2 are explained below:

Alternative SHL-2: Limited Action

Alternative SHL-2 contains components to maintain and potentially improve the effectiveness of the existing landfill cover system and to satisfy the Landfill Post-Closure Requirements of 310 CMR 19.142 to reduce potential future exposure to contaminated groundwater. Key components of this alternative include:

- survey of Shepley's Hill Landfill;
- evaluation/improvement of stormwater diversion and drainage;
- landfill cover maintenance;
- landfill gas collection system maintenance;
- long-term groundwater monitoring;
- long-term landfill gas monitoring;
- institutional controls;
- educational programs;
- design of groundwater extraction system
- annual reporting to MADEP and USEPA; and
- five-year site reviews.

Each of these components is described in the following paragraphs.

Survey of Shepley's Hill Landfill. Prior to design and implementation of remedial actions at Shepley's Hill Landfill, an accurate topographic survey of the landfill surface is required. No survey has been done since completion of the last phase of landfill

capping. The estimated cost of this alternative includes an aerial survey of Shepley's Hill Landfill. It also includes the costs to survey the elevation and horizontal location of monitoring wells or piezometers installed as part of remedial alternative implementation, and to prepare record drawings.

Evaluation/Improvement of Stormwater Diversion and Drainage. Stormwater diversion and drainage systems at and adjacent to Shepley's Hill Landfill will be evaluated as part of this alternative. Modifications for improvement will be implemented if the evaluation indicates they would be practical and cost-effective. The evaluation will focus on the following items of concern:

- landfill cap runoff patterns and drainage ditch flow capacities;
- potential run-under along the western edge of the landfill, particularly where the existing geomembrane cap may not have a good seal with the underlying bedrock; and
- the effectiveness of stormwater drainage systems upgradient of the landfill (i.e., at the transfer station, tire recycling station, DRMO yards, and along Market Street) at diverting run-off from potential infiltration areas upgradient of the landfill.

Detailed plans for evaluating stormwater diversion and drainage would be developed during the alternative's design phase and submitted for regulatory agency review and concurrence.

Landfill Cover Maintenance. A small area of ponded water in the northwestern section of the landfill is proposed to be drained and regraded to minimize stress on the cover system and potential for leakage through the PVC geomembrane. The area is approximately 100 feet in diameter and is estimated to be about 1 foot deep. The water would be pumped out and the ponded area backfilled with common borrow to bring the area up to the desired grade. A new section of PVC geomembrane would be installed on top of the fill and seamed to the existing geomembrane cap to provide a low permeability surface in this area.

At the northern end of the landfill, erosion of cover soil in sections of the drainage swales has occurred in the past, exposing PVC geomembrane. This erosion has been repaired, but may require additional repair in the future.

Annual inspections are proposed to monitor the condition of the landfill cover at Shepley's Hill Landfill, including monitoring wells, cover surface, and drainage swales to determine if maintenance is needed. Grass will be mowed annually and cover repairs made if required. Landfill maintenance and mowing would be scheduled to minimize

potential adverse effects to the Grasshopper Sparrow, a state-listed species of special concern that may nest on the cover.

Detailed plans for landfill cover maintenance would be developed during the alternative's design phase and submitted for regulatory agency review and concurrence.

Landfill Gas Collection System Maintenance. Annual inspections are proposed to monitor the Shepley's Hill Landfill gas collection system and provide any necessary repairs.

Long-term Groundwater Monitoring. Groundwater monitoring is proposed to monitor groundwater quality at Shepley's Hill Landfill and to assess future environmental impacts. Based on the hydrogeologic interpretation and analytical data presented in the RI Addendum report, the FS report presents proposed monitoring locations and analytical parameters for a conceptual long-term groundwater monitoring program. The conceptual plan includes installation of three new monitoring wells at the north end of the landfill to create nested triplets of shallow/water table, mid-depth, and deep overburden monitoring wells at SHL-9/SHL-22 and SHL-5. The monitoring wells that are included in the conceptual program would be sampled semi-annually for a minimum of 30 years, consistent with 310 CMR 19.142. Table 5-3 of the FS report presents proposed monitoring locations and analytical parameters for a conceptual long-term groundwater monitoring program.

Detailed plans for long-term groundwater monitoring would be developed during the alternative's design phase and submitted for regulatory agency review and concurrence.

Long-term Landfill Gas Monitoring. As part of post-closure monitoring activities, landfill gas will be monitored quarterly at landfill gas vents and analyzed in the field by direct reading instruments for lower explosive limit and total organic gases. On a semiannual basis, samples will be collected from the two vents with the highest field measurements and analyzed for TCL VOCs. These samples will be collected and analyzed in accordance with USEPA Method TO 14. Detailed plans for landfill gas monitoring would be developed during the alternative's design phase and submitted for regulatory agency review and concurrence.

Institutional Controls. Institutional controls are proposed in the form of zoning and deed restrictions for any property released by the Army at Shepley's Hill Landfill during Fort Devens base-closure activities. The Fort Devens Preliminary Reuse Plan, Main and North Posts has proposed that Army land bordering Plow Shop Pond be zoned for open space and rail-related uses. By pre-emptying residential use, these controls would help limit human exposure. In addition, the Army would place deed restrictions on landfill area property to prohibit installation of drinking water wells. This, in combination with landfill capping and long-term groundwater monitoring, would protect potential human

receptors from risks resulting from exposure to contaminated groundwater. There are no current human receptors for groundwater exposure. Institutional controls would be drafted, implemented and enforced in cooperation with state and local governments.

Educational Programs. Periodic public meetings and presentations would be conducted to increase public awareness. This would help keep the public informed of the site status, including both its general condition and remaining contaminant levels. This could be accomplished by conducting public meetings every five years coincident with the five-year site reviews for Shepley's Hill Landfill. The presentation would summarize site activities and the results of monitoring programs.

Design of Groundwater Extraction System. The Army will conduct predesign hydrogeologic studies and prepare a 60 percent complete engineering design for groundwater extraction and discharge to the Town of Ayer wastewater treatment facility. Predesign studies may include installation of several additional piezometers in and around the landfill, collection of additional groundwater elevation data, and updating/refining the groundwater model. Detailed plans for monitoring the piezometers will be developed as part of the long-term groundwater monitoring plan. The 60 percent complete engineering design will begin in 1996 and be completed prior to the first five-year site review, scheduled for 1998.

Annual Reporting to MADEP and USEPA. Reports which would include a description of site activities and a summary of results of environmental monitoring would be submitted annually to MADEP and USEPA. This reporting would satisfy the requirements of 310 CMR 19.132 and 19.142.

Five-Year Site Reviews. Under CERCLA 121c, any remedial action (or lack thereof) that results in contaminants remaining on-site must be reviewed at least every five years. During five-year reviews, an assessment is made of whether the implemented remedy is protective of human health and the environment and whether the implementation of additional remedial action is appropriate.

The five-year site reviews for Alternative SHL-2 will evaluate the alternative's effectiveness at reducing potential human health risk from exposure to groundwater and at preventing groundwater from contributing to Plow Shop Pond sediment contamination in excess of human health and ecological risk-based values. These evaluations will be based on how successful the alternative is at attaining PRGs at individual wells in two distinct monitoring well groups. Well Group 1 consists of wells, primarily at the north end of the landfill, where PRGs have been attained historically. Well Group 2 consists of wells where historically PRGs have not been attained.

The goal of Alternative SHL-2 is to maintain groundwater quality below PRGs at Group 1 wells, and to attain PRGs at Group 2 wells. Since groundwater quality

historically attains PRGs in Group 1 wells, Alternative SHL-2 will be considered effective if five-year site reviews show that this condition is maintained.

Evaluating effectiveness at Group 2 wells is less straightforward. Installation of the geomembrane cap over the most upgradient areas at Shepley's Hill Landfill (i.e., areas in the Phase IV-B closure) was not completed until May 1993. Based on groundwater modeling, it is estimated that the average time needed for groundwater to travel from these upgradient areas to downgradient wells SHL-11 and SHL-20 may be 10 to 14 years or longer. An equal or greater number of years may be needed for downgradient groundwater quality at these wells to attain PRGs. Overall groundwater quality is expected to improve and potential risk is expected to decrease during this period, although at some wells, certain chemicals may show small short-term increases in concentration while other chemicals show decreases in concentrations and overall risk is reduced.

The Army proposes to use reduction of risk rather than reduction of concentration as a measure of progress toward attainment of PRGs because this approach focuses on the cleanup of arsenic which is the primary contributor to risk in the Group 2 wells. This approach prevents a situation in which failure to attain a concentration reduction goal for a minor contributor to risk (e.g., 1,2-dichloroethane where a reduction of 2.5 ppb represents a 50 percent reduction in concentration exceeding the PRG) overshadows the achievement of 50 percent or greater reduction in the concentration of arsenic. In the Group 2 wells, a 50 percent reduction in the concentration of arsenic approximates a 50 percent reduction in groundwater risk, while a 50 percent reduction in the concentration of 1,2-dichloroethane represents less than a 1 percent reduction in groundwater risk. Alternative SHL-2 will be considered effective if five-year reviews show an ongoing reduction of potential human health risk at Group 2 wells and the ultimate attainment of PRGs by January 2008.

The specific criteria for evaluating the effectiveness of Alternative SHL-2 are stated below.

> Group 1 Wells. For Group 1 wells where analyte concentrations have historically attained PRGs, Alternative SHL-2 will be considered effective if concentrations of individual chemicals within individual wells do not show statistically significant PRG exceedances. To determine statistical significance, the Army will apply methods consistent with the regulations at 40 CFR 264.97, 40 CFR 258.53, and 310 CMR 30.663.
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> Group 2 Wells. For Group 2 wells where chemical concentrations have exceeded PRGs in the past, Alternative SHL-2 will be considered effective if a 50 percent reduction in the increment of risk between PRG concentrations and baseline concentrations for chemicals of concern within individual wells is achieved by

January 1998, if an additional 25 percent (75 percent cumulative) is achieved by January 2003, and if PRGs are attained by January 2008.

The Army will apply methods consistent with the regulations at 40 CFR 264.97, 40 CFR 258.53, and 310 CMR 30.663 to estimate chemical concentrations at baseline conditions. Analytical data collected during RI (August and December 1991) and Supplemental RI (March and June 1993) activities will be used to estimate the baseline conditions. The detailed approach would be developed during the design phase and submitted for regulatory agency review and concurrence.

A major consideration in assessing the protectiveness of Alternative SHL-2 and whether additional remedial actions may be appropriate will be the basis on which individual PRGs were set. The Army will consider the implementation of additional remedial actions if the above criteria are not met for any chemicals for which PRGs were based on MCLs (40 CFR 141) and for manganese. No MCL has been established for manganese. The PRG for manganese was based on background concentrations because background concentrations exceed the risk-based concentration derived from the available reference dose value ($5x10^{-3}$ milligrams/kilograms/day). This approach for setting PRGs and for evaluating the effectiveness of landfill closure is consistent with USEPA guidance contained in *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim*, December 1991, and with 40 CFR 258.55.

The Army will not consider additional remedial actions under CERCLA if PRGs are not attained for aluminum and iron. The PRGs for aluminum and iron were based on background concentrations because dose/response values were not available.

Similarly, the Army will not consider additional remedial actions if the PRG is not attained for sodium. The PRG for sodium was based on the health advisory for individuals on a reduced sodium diet.

Estimated Time for Restoration: Approximately 12 months for engineering evaluations, design, and construction.
Estimated Capital Costs: $928,000
Estimated Operation and Maintenance Costs: $1,291,000
(net present worth)
Estimated Total Costs: $2,219,000
(net present worth, assuming 5% discount rate)

Other Alternatives Evaluated in the FS

The public is invited to comment not only on the preferred alternative, but also on the other four alternatives that the Army evaluated in detail. Each of these alternatives is described briefly below. A more detailed description of each alternative can be found in the FS report. The following table summarizes the preferred alternative and the four other alternatives.

ALTERNATIVE	SUMMARY OF KEY COMPONENTS
Alternative SHL-2: Limited Action (Preferred Alternative)	• Evaluation/improvement of stormwater drainage • Long-term maintenance and environmental monitoring • Implementation of institutional controls • Scheduled review of alternative performance • Design of groundwater extraction system
Alternative SHL-1: No Action	• No further action is proposed
Alternative SHL-5: Collection/ Ion Exchange Treatment/ Surface Water Discharge	• Evaluation/improvement of stormwater drainage • Long-term maintenance and environmental monitoring • Groundwater extraction, on-site treatment, and discharge • Implementation of institutional controls • Scheduled review of alternative performance
Alternative SHL-9: Collection/Discharge to POTW (Contingency Remedy)	• Evaluation/improvement of stormwater drainage • Long-term maintenance and environmental monitoring • Groundwater extraction and discharge to Ayer POTW • Implementation of institutional controls • Scheduled review of alternative performance
Alternative SHL-10: Installation of RCRA Cap	• Installation of RCRA cap • Long-term maintenance and environmental monitoring • Implementation of institutional controls • Scheduled review of alternative performance

Alternative SHL-1: No Action

The No Action alternative does not contain any remedial action components to reduce or control potential risks. No institutional controls would be implemented to prevent future human exposure, and existing activities to maintain existing systems and monitor for potential future releases would be discontinued. Alternative SHL-1 is developed to provide a baseline for comparison with the other remedial alternatives.

Estimated Time for Restoration: not applicable
Estimated Capital Costs: $0
Estimated Operation and Maintenance Costs: $0
(net present worth)
Estimated Total Costs: $0
(net present worth, assuming 5% discount rate)

Alternative SHL-5: Collection/Ion Exchange Treatment/Surface Water Discharge

Alternative SHL-5 consists of components that, in conjunction with the components of Alternative SHL-2, would provide additional controls to prevent off-site migration of contaminated groundwater. Alternative SHL-5 consists of constructing a groundwater extraction system, constructing an on-site groundwater treatment facility that includes **carbon adsorption**, **sand filtration**, and **ion exchange** treatment units, installing an effluent pipeline for discharging treated groundwater to Nonacoicus Brook, and pumping and treating groundwater to remove groundwater contaminants.

Estimated Time for Restoration: Approximately 18 months for pre-design studies, design, and construction. Groundwater extraction and treatment assumed to continue for a minimum of 30-years.
Estimated Capital Costs: $2,577,000
Estimated Operation and Maintenance Costs: $6,549,000
(net present worth)
Estimated Total Costs: $9,126,000
(net present worth, assuming 5% discount rate)

Alternative SHL-9: Collection/Discharge to POTW

Alternative SHL-9, the contingency remedy, adds the components of groundwater extraction and discharge to the Town of Ayer POTW to Alternative SHL-2 to provide additional control to prevent off-site migration of contaminated groundwater. Key components of Alternative SHL-9 include:

- design, construction, operation, and maintenance of groundwater extraction and discharge facilities;
- survey of Shepley's Hill Landfill;
- evaluation/improvement of stormwater diversion and drainage;
- landfill cover maintenance;
- landfill gas collection system maintenance;
- long-term groundwater monitoring;
- long-term landfill gas monitoring;
- institutional controls;

- educational programs;
- annual reporting to MADEP and USEPA; and
- five-year site reviews.

The major difference between Alternative SHL-9 and Alternative SHL-2 is the construction and operation of groundwater extraction and discharge facilities. Data collected during pre-design studies would be used to optimize the size and location of groundwater extraction wells at Shepley's Hill Landfill. Following construction of the groundwater extraction facilities, contaminated groundwater would be pumped to a discharge manhole anticipated to be located on Scully Road near the north end of the landfill. There, the groundwater would combine with domestic wastewater and flow to the Town of Ayer POTW for treatment and subsequent discharge. The Ayer POTW, with a capacity of 1.79 million gallons per day (MGD), would be able to handle the additional anticipated volume of 20 to 30 gallons per minute (0.029 to 0.043 MGD).

Review of available groundwater monitoring data indicates that pretreatment of the groundwater will not be needed to meet existing pretreatment standards established by the Town of Ayer. The Army would monitor the groundwater discharge to the POTW, however, and if necessary install pretreatment facilities to meet pretreatment standards. The Army would pay a sewer user fee to the town based on the volume of water discharged to the POTW.

Estimated Time for Restoration: Approximately 15 months for pre-design studies, design, and construction. Groundwater extraction and discharge to POTW assumed to continue for a minimum of 30-years.
Estimated Capital Costs: $1,184,000
Estimated Operation and Maintenance Costs: $2,690,000
(net present worth)
Estimated Total Costs: $3,874,000
(net present worth, assuming 5% discount rate)

Alternative SHL-10: Installation of RCRA Cap

Alternative SHL-10 consists of building a new landfill cover system on top of the existing cover system at Shepley's Hill Landfill. The new cover system would be designed to meet USEPA **Resource Conservation and Recovery Act** (RCRA) performance criteria and design guidance for hazardous waste landfills. The principal components of the new cover system would be a 24-inch layer of low permeability soil in intimate contact with a geomembrane. Maintenance activities, monitoring and reporting requirements, and institutional controls would be similar to those of Alternative SHL-2.

Estimated Time for Restoration: Approximately three years required for design and construction.
Estimated Capital Costs: $19,645,000
Estimated Operation and Maintenance Costs: $1,291,000 (net present worth)
Estimated Total Costs: $20,936,000 (net present worth, assuming 5% discount rate)

Summary of the Comparative Analysis of Alternatives

Nine criteria are used under CERCLA to select a remedy that meets the goals of protecting human health and the environment, maintaining protection over time, and minimizing untreated waste. Definitions of the nine criteria and a summary of the Army's evaluation of the five alternatives using the nine criteria are provided below:

1. **Overall Protection of Human Health and the Environment** addresses how an alternative as a whole will protect human health and the environment. This includes an assessment of how public health and environmental risks are properly eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

This criteria, according to CERCLA, must be met for a remedial alternative to be chosen as a final site remedy. At Shepley's Hill Landfill the existing cover system isolates landfill materials from the environment, blocks infiltration, and based on computer modeling, diverts groundwater that would otherwise discharge to Plow Shop Pond. Historical groundwater monitoring between the landfill and Plow Shop Pond has shown analyte concentrations in excess of PRGs; however, no current residential exposure to groundwater has been identified, and the existing cap prevents infiltration of contaminants into groundwater downgradient of the landfill. Alternatives SHL-1, SHL-2, SHL-5, and SHL-9, all of which rely on the existing cover to isolate waste, prevent infiltration, and reduce groundwater discharge to the pond, are considered equally protective of human health under current exposure scenarios. Alternative SHL-10 which proposes to replace the existing geomembrane cover with a **composite cover** would not afford significantly greater protection under current conditions.

Differences in protectiveness may exist under future exposure conditions. Alternative SHL-1 proposes no action to prevent future residential exposure to groundwater or to maintain and monitor the long-term performance of the existing cover. The remaining alternatives all propose to implement zoning and deed restrictions to prevent future residential exposure to groundwater and to

maintain and monitor long-term cover performance. Once installed, the composite cover system proposed for Alternative SHL-10 would be younger and therefore potentially provide protection longer than the existing cover. However, its protectiveness at any given time would not be significantly greater than the anticipated performance of the existing cover. In addition, the five-year site reviews proposed for all alternatives provide the opportunity to implement additional remedial actions if they are needed. The installation of a composite cover system could be considered in the future if the existing cover system does not perform as anticipated. Alternatives SHL-5 and SHL-9, in addition to their reliance on the existing cover system, propose to extract contaminated groundwater for subsequent treatment and discharge. They therefore provide some redundancy or backup to achieve PRGs if the existing cover system does not perform as anticipated.

There is no ecological exposure to groundwater. Reductions in infiltration and leaching coupled with the diversion of groundwater that would otherwise discharge to Plow Shop Pond will provide protection of the environment. The potential differences in effectiveness of the evaluated alternatives at protecting the environment are similar to the differences discussed for future protection of human health.

2. Compliance with Applicable or Relevant and Appropriate Requirements addresses whether a remedy complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup options at a specific site. If an alternative cannot meet an ARAR, the analysis of the alternative must provide the rationale for invoking a statutory waiver.

Location-specific ARARs identified for the Shepley's Hill Landfill Operable Unit include regulations that protect wetlands, floodplains, and endangered species (i.e. the Grasshopper Sparrow, a state listed species of special concern). Alternatives SHL-1, SHL-2, and SHL-9 would not involve any activities anticipated to trigger wetlands or floodplain ARARs. Alternative SHL-5 would require construction of a discharge pipeline to Nonacoicus Brook and may trigger wetland and floodplain ARARs. Activities for all alternatives would be conducted or altered to comply with wetlands and floodplain ARARs. All of the alternatives would be subject to ARARs protecting endangered species. Activities performed for any of the alternatives would be planned to prevent or minimize adverse effects on the Grasshopper Sparrow and its habitat. In spite of this, implementation of Alternative SHL-10 would result in destruction of any nesting areas of the Grasshopper Sparrow which might exist at the landfill.

Alternatives SHL-1, SHL-2, and SHL-10 rely on cover system performance to comply with chemical-specific ARARs and PRGs. Currently groundwater at the northern end of the landfill meets PRGs, and landfill capping is expected to reduce leaching of landfill materials and the resulting groundwater contamination, thereby achieving PRGs along the eastern edge of the landfill. Alternatives SHL-5 and SHL-9 would comply with chemical-specific ARARs and PRGs with a combination of landfill capping and groundwater extraction. Groundwater exceeding PRGs would be extracted and treated or disposed of prior to exiting the site.

Several action-specific ARARs have been identified for the Shepley's Hill Landfill Operable Unit; the most important are the ones relating to landfill cover systems and landfill closure. The Massachusetts Solid Waste Management Regulations at 310 CMR 19.000 have been identified as applicable. USEPA Regulations for Owners and Operators of Permitted Hazardous Waste Facilities at 40 CFR 264 (RCRA Subtitle C), as well as USEPA Criteria for Municipal Solid Waste Landfills at 40 CFR 258 (RCRA Subtitle D), and Massachusetts Hazardous Waste Management Rules at 310 CMR 30.000 have all been identified as relevant and appropriate.

The design of the existing cover system at Shepley's Hill Landfill was approved by MADEP in 1985 pursuant to Massachusetts Sanitary Landfill regulations at 310 CMR 19.00. Provisions in 310 CMR 19.000 indicate that the conditions of the 1985 approval satisfy 310 CMR 19.000, therefore the existing cover is considered to comply with the applicable cover system requirements of 310 CMR 19.000. In addition, the existing cover meets the general performance standards of 310 CMR 19.000. The existing cover system also meets the performance standards of RCRA Subtitle C at 40 CFR 264.310, RCRA Subtitle D at 40 CFR 258, and Massachusetts Hazardous Waste Regulations at 310 CMR 30.000. The existing cover varies from USEPA guidance for RCRA final covers primarily in that it has a geomembrane hydraulic barrier rather than a composite hydraulic barrier. Alternatives SHL-1, SHL-2, SHL-5, and SHL-9, which rely on the existing cover, are therefore considered to comply with the applicable or relevant and appropriate requirements for cover systems. The cover system of Alternative SHL-10 would be designed to meet the applicable or relevant and appropriate requirements for cover systems as well as RCRA design guidance. The long-term monitoring and maintenance programs of all alternatives except Alternative SHL-1 would be designed to comply with the applicable requirements of 310 CMR 19.000.

Action-specific ARARs for landfill post-closure requirements would be met by all of the alternatives except Alternative SHL-1. Alternative SHL-5 would be

required to meet the substantive requirements of a federal National Pollutant Discharge Elimination System (NPDES) permit to discharge treated groundwater to Nonacoicus Brook. These alternatives would also be required to meet ARARs for disposal of filter cake and resin regeneration concentrate from groundwater treatment and to meet substantive requirements of a U.S. Army Corps of Engineers (USACE) permit, a MADEP license, and a Massachusetts water quality certification to construct a discharge pipeline to Nonacoicus Brook. Alternative SHL-9 would be required to meet the federal Clean Water Act General Pretreatment Requirements to discharge to the Town of Ayer POTW. Federal and state air quality regulations would be met by all the alternatives. Dust suppression techniques would be utilized, when necessary, for Alternatives SHL-5, SHL-9, and SHL-10 intrusive activities to meet air quality regulations.

3. Long-term Effectiveness and Permanence refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the cleanup levels have been met.

Alternative SHL-1 provides no controls or treatment in addition to the existing cover system to protect human health and the environment. Alternatives SHL-2 and SHL-10 rely on the effectiveness of a landfill cover system to achieve the remedial action objectives. The other alternatives utilize groundwater extraction and treatment in addition to the cover system to achieve remedial action objectives. All of the alternatives except SHL-1 include landfill post-closure and long-term groundwater monitoring to evaluate the long-term effectiveness. All the alternatives except SHL-1 include institutional controls. Institutional controls require cooperation by private parties and government agencies to be reliable and effective.

Alternatives SHL-5 and SHL-9 would utilize data obtained from the pre-design hydrogeological investigation to design a groundwater extraction system. This would allow design of an extraction system that is effective in capturing contaminated groundwater. However, groundwater extraction would not prevent landfill waste and/or its leachate from potentially contaminating the underlying aquifer; these alternatives rely on the cover system as discussed earlier.

4. Reduction of Toxicity, Mobility, or Volume through Treatment are three principal measures of the overall performance of an alternative. The 1986 amendments to the **Superfund** statute emphasize that, whenever possible, a remedy should be selected that uses a treatment process to reduce permanently the level of toxicity of contaminants at the site, the spread of contaminants away from the source of contamination, and the volume or amount of contamination at the site.

Alternatives SHL-1, SHL-2, and SHL-10 do not meet the statutory preference for treatment under CERCLA since these alternatives do not treat contaminants contained in groundwater or wastes at the site. Landfill capping which is a part of each of all the alternatives will reduce infiltration and the resulting leaching of contaminants, thus reducing contaminant mobility.

Alternatives SHL-5 and SHL-9 meet the CERCLA statutory preference for treatment. These alternatives would reduce the mobility of contaminants by extracting the groundwater for treatment or disposal. Alternative SHL-5 would generate concentrated waste streams from removal of contaminants that would require disposal. Alternative SHL-9 would discharge extracted groundwater to the Town of Ayer POTW. The POTW generates sludge from treating influent water which would require disposal.

5. Short-term Effectiveness refers to the likelihood of adverse effects on human health or the environment that may be posed during the construction and implementation of an alternative until cleanup goals are achieved.

Alternatives SHL-1 and SHL-2 would have the least likelihood for adverse effects during implementation because no intrusive activities would be required. Alternative SHL-1 would have the least impact during implementation because it would not involve construction or operation. Alternatives SHL-5 and SHL-9 involve installation of extraction wells and underground piping. A Health and Safety Plan would be followed during performance of these activities and during environmental monitoring to minimize the risk of site hazards to workers. Alternative SHL-5 would require transportation of treatment residuals and adherence to RCRA and U.S. Department of Transportation regulations to minimize potential risks to workers.

Site activities would be performed to minimize effects on the Grasshopper Sparrow and its habitat. Maintenance schedules for Alternatives SHL-2, SHL-5, and SHL-9 would be prepared to limit activities during the nesting season. Construction schedules for Alternatives SHL-5 and SHL-9 would be prepared to limit activities during nesting season to avoid direct impacts on the bird. Alternative SHL-10 would destroy any nesting areas of the Grasshopper Sparrow which might exist at the landfill.

6. Implementability refers to the technical and administrative feasibility of an alternative, including the ease of construction and operation; administrative feasibility; and availability of services, equipment, and materials to construct and operate the technology. Also evaluated is the ease of undertaking additional remedial actions.

Post-closure requirements included in all of the alternatives present no implementation problems. Equipment and services required for monitoring and maintenance are readily available. Zoning and deed restriction (i.e., institutional controls) included in all alternatives, except SHL-1, could be easily implemented by the Army. Enforcement by the Town of Ayer would be required.

Groundwater extraction systems used in Alternatives SHL-5 and SHL-9 would be easily designed and constructed. Many engineering companies are capable of designing and installing extraction systems. The treatment system proposed for Alternative SHL-5 utilizes sand filtration, carbon adsorption, and ion exchange, all of which are proven technologies with vendors available. Alternative SHL-9 would require a long-term discharge agreement between the Army and the Town of Ayer POTW prior to implementation. Initial discussions with representatives from the Town of Ayer POTW indicate a willingness to consider accepting the discharge. Many engineering and construction companies are qualified to design and install the cover system of Alternative SHL-10.

Alternative SHL-1, which only includes groundwater monitoring, would be the easiest alternative to implement at the site, and would have the least impact on future remedial actions.

7. Cost includes the capital (up-front) cost of implementing an alternative and the cost of operating and maintaining the alternative over the long term, and net present worth of both capital and operation and maintenance costs.

The capital, operation and maintenance, and total cost for each alternative is provided as part of the alternative description in the preceding sections on "The Army's Preferred Alternative" and "Other Alternatives Evaluated in the FS".

8. State Acceptance addresses whether, based on its review of the RI, RI Addendum, FS, and proposed plan, the state concurs with, opposes, or has no comment on the alternative the Army is proposing as the remedy for the AOCs. The Commonwealth of Massachusetts concurs with the Army's proposed plan.

9. Community Acceptance addresses whether the public concurs with the Army's proposed plan. Community acceptance of this proposed plan will be evaluated based on comments received at the upcoming public meeting and during the public comment period.

Of the nine criteria, protection of public health and compliance with all ARARs are considered threshold requirements that must be met by all remedies. The consideration of alternatives is balanced with respect to long-term effectiveness and permanence;

reductions of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. State and community concerns are considered modifying criteria factored into a final balancing of all criteria to select a remedy. Consideration of state and community comments may prompt the Army to modify aspects of the preferred alternative or decide that another alternative provides a more appropriate balance.

The Army's Rationale for Proposing the Preferred Alternative

The **National Contingency Plan** (NCP) requires the Army to select the alternative that meets the threshold criteria of protection and ARAR compliance, and best balances the remaining seven criteria. The Army believes that Alternative SHL-2 represents the best balance of the criteria, subject to field monitoring and verification. Because of the possibility that flow will behave differently than predicted by the computer model and that Alternative SHL-2, will not be successful, the Army has identified a contingent remedy: Alternative SHL-9. Alternative SHL-9, which consists of Alternative SHL-2 with the additional component of groundwater extraction and discharge, will best meet the NCP criteria if Alternative SHL-2 does not prove to be successful. To facilitate the potential implementation of this contingency action, the Army will conduct the necessary pre-design hydrogeologic studies and prepare a 60 percent complete engineering design for groundwater extraction as part of Alternative SHL-2. USEPA New England and MADEP have approved pumping contaminated groundwater from beneath the landfill and discharge to the Town of Ayer wastewater treatment facility for treatment and disposal.

The Army proposes Alternative SHL-2: Limited Action as the preferred alternative because it believes this alternative is the most practical approach to reduce potential risks that are outside of the USEPA target risk range and to protect human health and the environment at Shepley's Hill Landfill. In addition, this alternative attains ARARs and offers potential long-term effectiveness with little potential for short-term risks. The alternative is readily implementable at a moderate cost. Although named Limited Action, Alternative SHL-2 is based on the presence of an existing landfill cover system designed to comply with applicable MADEP criteria. Installation of the cover system was only completed in 1993, and Alternative SHL-2 provides an opportunity to monitor and evaluate the effectiveness of the cover system at controlling groundwater contamination. The proposal of Alternative SHL-2 as the preferred alternative is cost-effective and consistent with USEPA guidance contained in the USEPA document *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* which indicates that the most practical remedial alternative for landfills is generally containment by capping.

Alternative SHL-1 is not proposed as the preferred alternative because it does not contain any remedial action components to maintain and monitor the effectiveness of the existing cover or to reduce or control potential risks, and therefore it is not protective of human health and the environment.

Neither Alternative SHL-5 or SHL-9 is proposed as the preferred alternative because the Army believes that neither offers substantially greater protection of human health and the environment than Alternative SHL-2. Similar to Alternative SHL-2, both alternatives rely on the performance of the existing cover system to control groundwater contamination. These two alternatives differ from Alternative SHL-2 in that both include groundwater extraction and subsequent treatment/disposal as further means to control groundwater flow and contaminant migration. However, groundwater modeling of the effect of the existing cover system indicates that groundwater pumping is not necessary to prevent the discharge of contaminated groundwater to Plow Shop Pond. Furthermore, there is no current residential use of downgradient groundwater that necessitates groundwater pumping to control human exposure. Alternative SHL-5 costs approximately four times more than Alternative SHL-2, while Alternative SHL-9 costs approximately two times more than Alternative SHL-2. Therefore, in a comparison between Alternatives SHL-5 and SHL-9, the Army considers Alternative SHL-9 the more cost effective of the two.

The Army has not proposed Alternative SHL-10: Installation of RCRA Cap as the preferred alternative because the Army believes that the existing cover system meets the five performance criteria for a RCRA cap, and that installation of a RCRA cap would not provide greater protection of human health and the environment than Alternative SHL-2 or shorten the length of time needed to achieve PRGs in groundwater. In addition, the potential for adverse short-term effects on human health and the environment is the greatest for Alternative SHL-10 compared to the other alternatives. Finally, the estimated cost of Alternative SHL-10 is approximately ten times greater than the cost of the proposed preferred alternative.

Based on current information and analysis of the RI, RI Addendum, and FS reports, the Army believes that the preferred alternative, Alternative SHL-2 with the contingent remedy Alternative SHL-9, for control of groundwater contamination at Shepley's Hill Landfill is consistent with the requirements of the Superfund law and its amendments, specifically Section 121 of CERCLA, and to the extent practicable, the NCP. In the Army's estimation, the preferred alternative would achieve the best balance among the criteria used by USEPA to evaluate alternatives. The preferred alternative would provide short- and long-term protection of human health and the environment, would attain all federal and state ARARs, would reduce the mobility of the contaminants in groundwater, and would utilize permanent solutions to the maximum extent practicable.

For More Information

If you have questions about the site or would like more information, you may call or write:

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Glossary

Ambient Water Quality Criteria (AWQC): Federal criteria for the maximum concentration of contaminants in surface water considered protective of human health and aquatic life.

Applicable or Relevant and Appropriate Requirements (ARARs): ARARs include any state or federal statute or regulation that pertains to protection of human health and the environment in addressing certain site conditions or using a particular cleanup technology at a Superfund site. The Army must consider whether a remedial alternative meets ARARs as part of the process for selecting a cleanup alternative for a Superfund site.

Area of Contamination (AOC): A portion of a Superfund site where investigations have established that contamination exists and requires further assessment.

Background: A term used in hazardous waste site investigations to describe the levels of naturally-occurring compounds in the environment, not related to the release of pollutants.

Cap: A barrier placed to protect material beneath. At Superfund sites, capping is generally used to prevent human or environmental contact with wastes and to prevent rain water from washing waste down to the groundwater.

Carbon Adsorption: A water treatment process in which dissolved contaminants are adsorbed onto particles of specially prepared carbon. It is most effective for organic contaminants. Also known as activated carbon adsorption.

Cleanup: Actions taken because of the release or threatened release of hazardous substances to reduce the risks to human health or the environment. The term "cleanup" is often used broadly to describe various aspects of a remedial response.

Composite Cover: A landfill cover system that consists of both a low-permeability soil layer and a geomembrane.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The act created a special tax that goes to a trust fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Downgradient: The direction in which groundwater flows. The slope of the water table determines the hydraulic gradient under which groundwater movement takes place. The term downgradient also refers to the portion of groundwater that has migrated away from a contaminant source.

Feasibility Study (FS): A study that develops and evaluates remedial alternatives for the cleanup of Superfund sites.

Geomembrane: A thin, flexible, and essentially impermeable membrane used as a solid, liquid, or vapor barrier. Geomembranes are commonly manufactured from polyvinyl chloride or polyethylene.

Groundwater: Water found beneath the earth's surface which fills pores between materials such as sand, soil, and gravel, and fills cracks in bedrock, and often serves as a source of drinking water.

Hot Spots: Portions of an AOC which are characterized by localized, elevated levels of contamination.

Institutional Controls: Controls placed on property to restrict access and future development, such as zoning and deed restrictions.

Inorganic Chemicals: Chemical elements or compounds that do not contain carbon as the principal component. Inorganics include mineral materials and metals, including aluminum, arsenic, chromium, copper, iron, lead, mercury, nickel, and sodium.

Ion Exchange: A water treatment process in which dissolved ions in the water are exchanged with ions on the surface of a specially prepared ion exchange material.

Maximum Contaminant Level (MCL): The maximum permissible level of a contaminant in drinking water. These levels are determined by USEPA and are applicable to all drinking water supplies.

Monitoring Well: A well drilled to "monitor" groundwater quality and movement. A well of this type does not supply water for drinking or industrial use. Samples from a monitoring well are analyzed to detect the presence of contaminants. Comparing water levels in monitoring wells shows the direction of groundwater flow.

National Contingency Plan (NCP): The federal regulation that guides the Superfund program.

Net Present Worth: The amount of money necessary to secure the promise of future payment, or series of payments, at an assumed interest rate.

Operable Unit: A discrete action that comprises an incremental step toward a final remedy. Operable units may address geographic portions of a site, specific site problems, or the initial phase of an action.

Organic Chemicals: A group of chemical compounds composed primarily of carbon and hydrogen.

Parts per billion (ppb): An expression of concentration.

Polychlorinated Biphenyls (PCBs): A class of organic compounds used since 1926, primarily in electrical transformers, as insulators and coolants.

Polynuclear Aromatic Hydrocarbons (PAHs): A subgroup of organic compounds with a chemical structure represented by two or more aromatic compounds. PAHs are used industrially in the production of automobile tires and rubber stoppers. Also, PAHs are often found as by products of the refining and combustion of petroleum and coal.

Preliminary Remediation Goals (PRGs): Numerical goals for site cleanup that are protective of human health and the environment and that comply with ARARs.

Record of Decision (ROD): A public document that explains the cleanup alternative to be used at a National Priorities List (NPL) site. The ROD is based on information and technical analysis generated during the RI and FS, and on consideration of the public comments and community concerns. An interim ROD is prepared to explain and document the rationale for an interim remedial action.

Remedial Alternative: An option evaluated during the FS to address the source and/or migration of contaminants at a Superfund site to meet cleanup goals.

Remedial Investigation: An investigation that evaluates the nature and extent of contamination at a hazardous waste site, and helps to direct the types of cleanup options that are evaluated in the FS.

Resource Conservation and Recovery Act (RCRA): The federal statute constructed in several steps to provide for "cradle to grave" regulation of both solid waste and hazardous waste management (i.e., permitting of new facilities and management of new and existing facilities, including cleanup and closure). Existing facilities are those regulated facilities operating as of the effective date (i.e., November 19, 1980). the broad goals set by RCRA are to (1) protect human health and the environment;

(2) reduce waste and conserve energy and natural resources; and (3) reduce or eliminate the generation of hazardous waste as expeditiously as possible.

Risk Assessment: A qualitative or quantitative evaluation of human health and ecological risk resulting from exposure to a chemical or physical agent (pollutant); combines exposure assessment information with toxicity information to estimate risk. A baseline risk assessment evaluates the risks associated with existing conditions and their relative consequences should no further action be taken.

Sand Filtration: A water treatment process in which suspended materials are removed from water by passing the water through a bed of sand.

Sediments: The sand or mud found at the bottom and sides of bodies of water, such as creeks, rivers, streams, lakes, swamps, and ponds. Sediments typically consist of soil, silt, clay, plant matter, and sometimes gravel.

Semivolatile Organic Compound (SVOC): A group of chemical compounds composed primarily of carbon and hydrogen that have less of a tendency to evaporate (or volatilize) into the air from water or soil than VOCs. SVOCs include substances such as naphthalenes and phthalates.

Superfund: The common name for CERCLA, the Comprehensive Environmental Response, Compensation, and Liability Act.

Surface Water: Bodies of water on the surface of the earth, such as rivers, lakes, and streams.

Volatile Organic Compound (VOC): A group of chemical compounds composed primarily of carbon and hydrogen which are characterized by their tendency to evaporate (or volatilize) into the air from water or soil. VOCs include substances that are contained in common solvents and cleaning fluids.