Per the Federal Facility Agreement for Iowa Army Ammunition Plant, Article X.B.1, the attached document is the final version of the submitted document.

SUPERFUND PROPOSED PLAN

IOWA ARMY AMMUNITION PLANT
SOILS OPERABLE UNIT #1

MIDDLETOWN, IOWA

JUNE 17, 1998

Hand Carried to
L. Landeche, MHC
18 Jun 98

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PURPOSE OF THE PROPOSED PLAN

This Proposed Plan describes the remedial alternatives considered for the Soils Operable Unit (OU) #1 at the Iowa Army Ammunition Plant (IAAAP) Superfund site and identifies the preferred remedial alternative with the rationale for this preference. The Proposed Plan was developed by the U.S. Army (Army), as lead agency, with support from the U.S. Environmental Protection Agency (EPA). The Army is issuing the Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and Section 300.430(f) of the National Contingency Plan (NCP). The alternatives summarized here are described in the remedial investigation and feasibility study (RI/FS) reports which should be consulted for a more detailed description of all the alternatives.

This Proposed Plan is being provided as a supplement to the RI/FS reports to inform the public of the Army's and EPA's preferred remedy and to solicit public comments pertaining to all the remedial alternatives evaluated, as well as the preferred alternative.

The remedy described in this Proposed Plan is the preferred remedy for the site. Changes to the preferred remedy or a change from the preferred remedy to another remedy may be made, if public comments or additional data indicate that such a change will result in a more appropriate remedial action. The final decision regarding the selected remedy will be made after the Army and EPA have taken into consideration all public comments. The Army and EPA may select a remedy other than the preferred remedy, based on the comments received.

COMMUNITY ROLE IN SELECTION PROCESS

The Army and EPA rely on public input to ensure that the concerns of the community are considered in selecting an effective remedy for each Superfund site. To this end, the RI/FS reports (including the Revised Remedial Investigation/Risk Assessment dated May 21, 1996 and the Final Soils Feasibility Study dated June 19, 1998), this Proposed Plan, and supporting documentation have been made available to the public for a public comment period which begins on June 19, 1998 and concludes on July 19, 1998.

A public meeting will be held during the public comment period at the Best Western Motor Inn, 3001 Winegard Drive, Burlington, Iowa 52601, on July 9, 1998 at 7:00 p.m. to present the conclusions of the RI/FS, to elaborate further on the reasons for recommending the preferred remedial alternative, and to receive public comments.

Comments received at the public meeting, as well as written comments, will be documented in the Responsiveness Summary Section of the Record of Decision (ROD), the document which formalizes the selection of the remedy.

All written comments should be addressed to:

Mr. Rodger Allison
Iowa Army Ammunition Plant
Attn: SIOIA-PPE (Allison)
17571 State Highway 79
Middletown, IA 52638-9701

Copies of the RI/FS reports, Proposed Plan, and supporting documentation are available at the following repositories:

Iowa Army Ammunition Plant
Visitor Reception Area
Building 100-101
Iowa Army Ammunition Plant
Middletown, Iowa 52638-5000
(319) 753-7710

Burlington Public Library
501 N. Fourth Street
Burlington, Iowa 52601
(319) 753-1647

Danville City Hall
105 W. Shepard
Danville, Iowa 52623
(319) 392-4685

SITE BACKGROUND

The IAAAP is a 19,127 acre Load, Assembly, and Pack (LAP) munitions facility in eastern Iowa, 10 miles west of Burlington. The IAAAP is owned by the U.S. Government and operated by a contractor (currently Mason & Hanger-Silas Mason Co., Inc.) for the Department of the Army. Since 1941, the IAAAP has produced projectiles, warheads, demolition charges, anti-tank weapons, primers, and fuses. Only a few of the production lines currently remain in operation. The primary source of contamination at the site may be attributed to past operating practices where explosives-contaminated wastewaters and sludges were discharged to uncontrolled lagoons and impoundments on-site. Additional sources of contamination include open burning of explosives materials and munitions, and landfilling of waste material. Figure 1 provides a location map and Figure 2 provides a site plan.

The site was listed on the EPA's National Priorities List (NPL) in 1990. A Federal Facilities Agreements (FFA) was signed between the EPA and the Army for the cleanup of the site which was

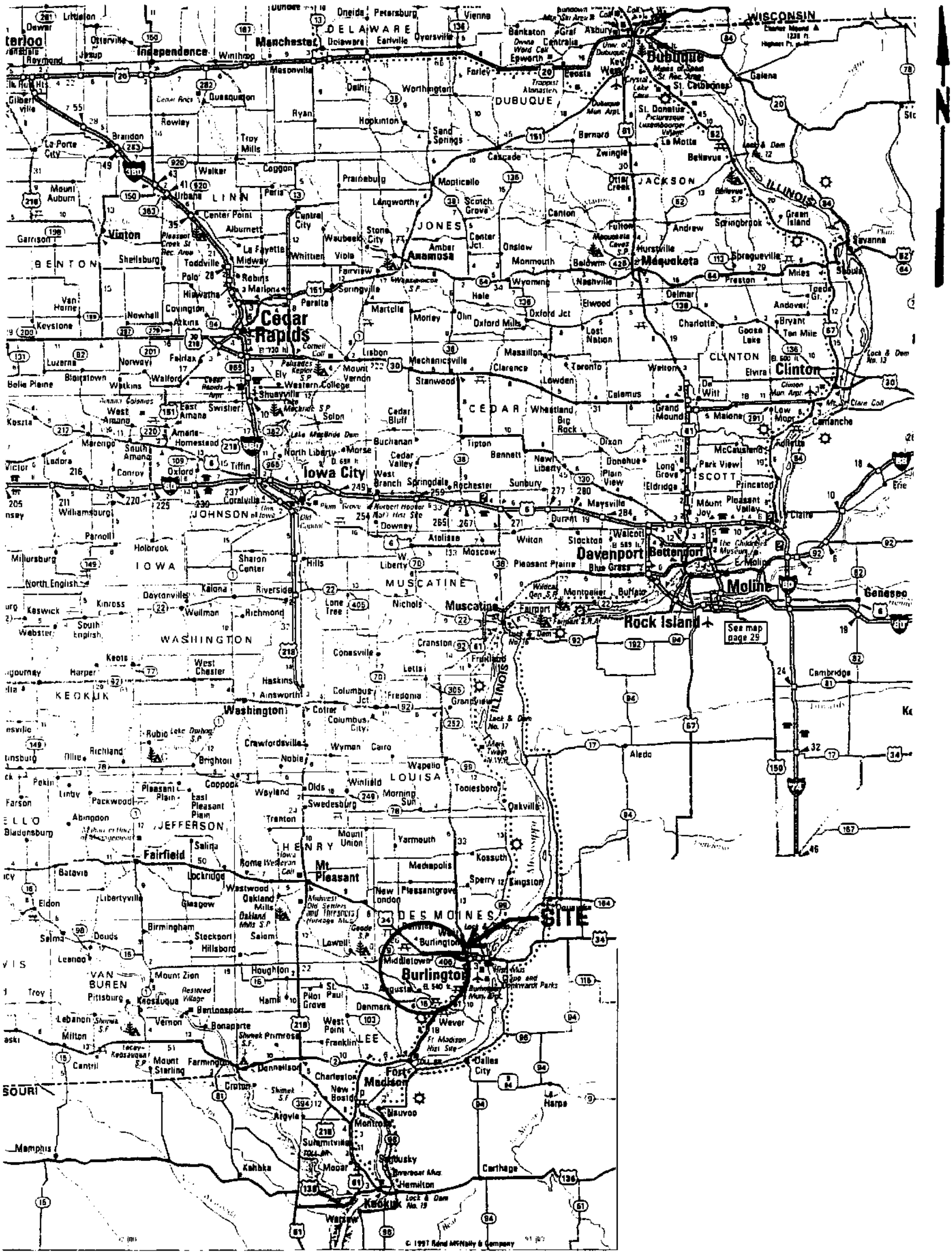

Figure 1

SITE LOCATION MAP

SOILS OU No.1 PROPOSED PLAN

IOWA ARMY AMMUNITION PLANT

Middletown, Iowa

SOURCE: Minnesota's Geology

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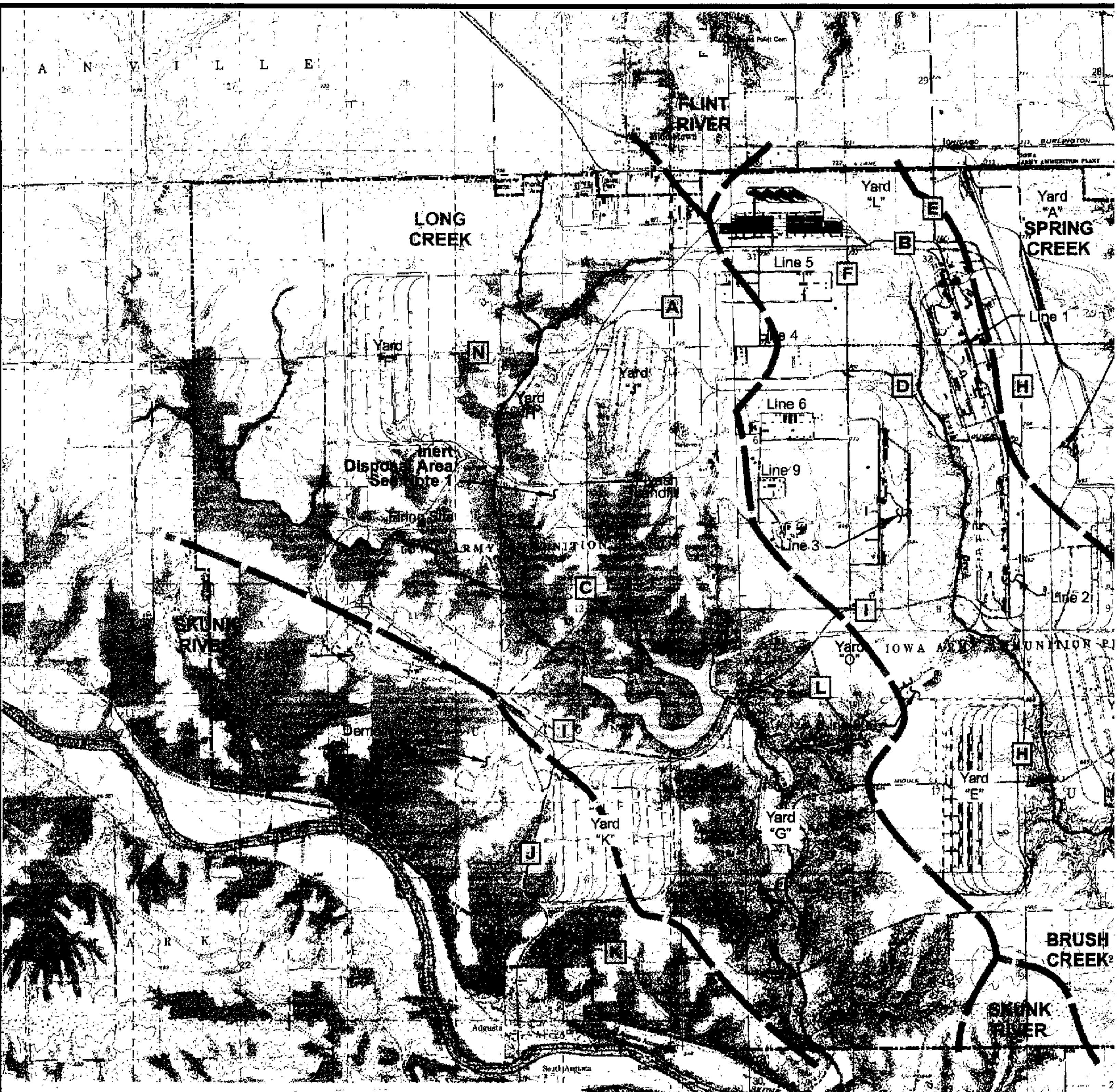

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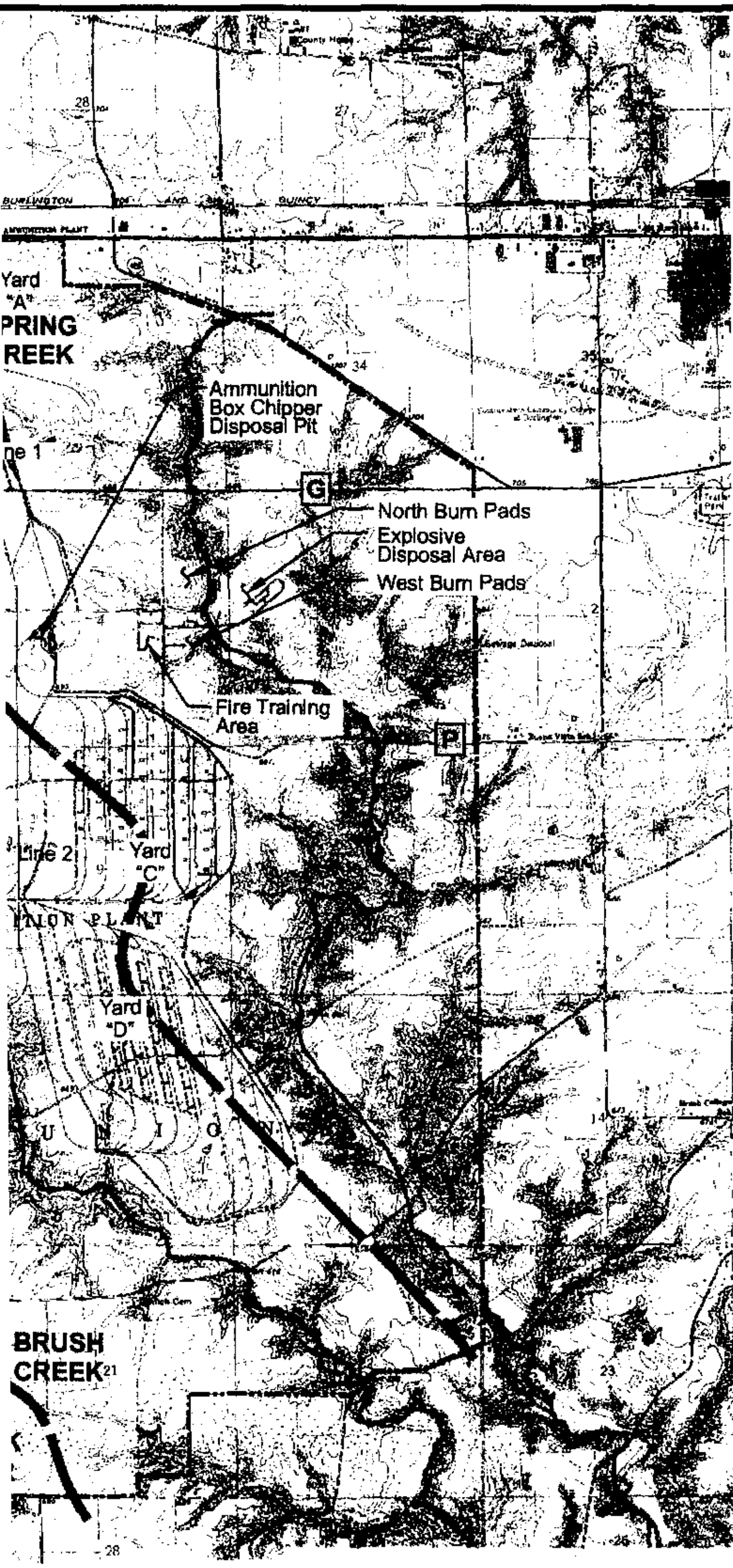
HARZA *Consulting Engineers and Scientists*



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LEGEND:

A ROAD NAME

PLANT PROPERTY BOUNDARY

DRAINAGE BASIN BOUNDARY

RIVER / STREAM

NOTE:

1. INCLUDES INERT LANDFILL, SOIL REPOSITORY, AND CAMU.

Figure 2

DRAINAGE BASINS AND SITE FEATURES MAP

SOILS OU No. 1 PROPOSED PLAN

IOWA ARMY AMMUNITION PLANT

Middletown, Iowa

effective on December 10, 1990, following public comment. The FFA, which is also called an Interagency Agreement (IAG), provides a framework for the CERCLA response actions to be performed at the site, including the investigation and cleanup of contamination. The State of Iowa has declined to participate as a signatory party to this FFA.

The Department of Defense (DOD) has established the Defense Environmental Restoration Account (DERA) to address CERCLA sites within the responsibility of the DOD. The Army, as an agency within the DOD, is the lead agency for implementing the interim remedial action at the IAAAP site. As the support agency, the EPA oversees the cleanup activities conducted by the Army to ensure that the requirements of CERCLA and the National Contingency Plan (NCP) have been met.

SUMMARY OF PREVIOUS INVESTIGATIONS AND ACTIONS

Numerous investigations have been conducted at the site by the Army from 1975 to the present to investigate soil and groundwater contamination. Based on data collected at the site, the Army has initiated response actions at the IAAAP to address soil contamination at several areas across the IAAAP. These actions are documented in several Action Memoranda from 1995 through 1997 and an Interim Action Record of Decision (ROD) signed by EPA in March 1998. Under these response actions, cumulative risk levels were determined for soils at each source based on sampling and analysis for contaminants of concern. Soils with the highest contaminant concentrations were excavated and stockpiled in a lined storage facility known as as a Corrective Action Management Unit (CAMU) for subsequent treatment. Moderately contaminated soils were excavated and disposed in an on-site Soil Repository. Lightly contaminated soils were disposed under the synthetic cap of the Inert Landfill on site. Figure 3 illustrates the locations of the CAMU, the Soil Repository, and the Inert Landfill.

While the Interim Action ROD requires that the highly contaminated soils stockpiled in the CAMU be treated to reduce contaminant toxicity, mobility, and volume, it does not specify the treatment method to be used. This Proposed Plan identifies the preferred remedy for treatment of the soils stockpiled in the CAMU prior to final disposal. The nature of the soils requiring treatment is as follows:

- Approximately 9,000 cubic yards of soil contaminated with explosives
- Approximately 600 cubic yards of soil contaminated with explosives plus metals
- Approximately 200 cubic yards of soil contaminated with semi-volatile organic compounds (SVOCs)

The Interim Action ROD also identified approximately 300 cubic yards of soil to be excavated and stabilized because of the presence of radionuclides. However, there is currently some uncertainty about whether these soils are actually contaminated above naturally occurring levels. If excavation and treatment ultimately is required, these soils will be addressed later under a separate OU or response action.

Excavation of materials from the Line 1 Impoundment and the Line 800 Lagoon was completed in

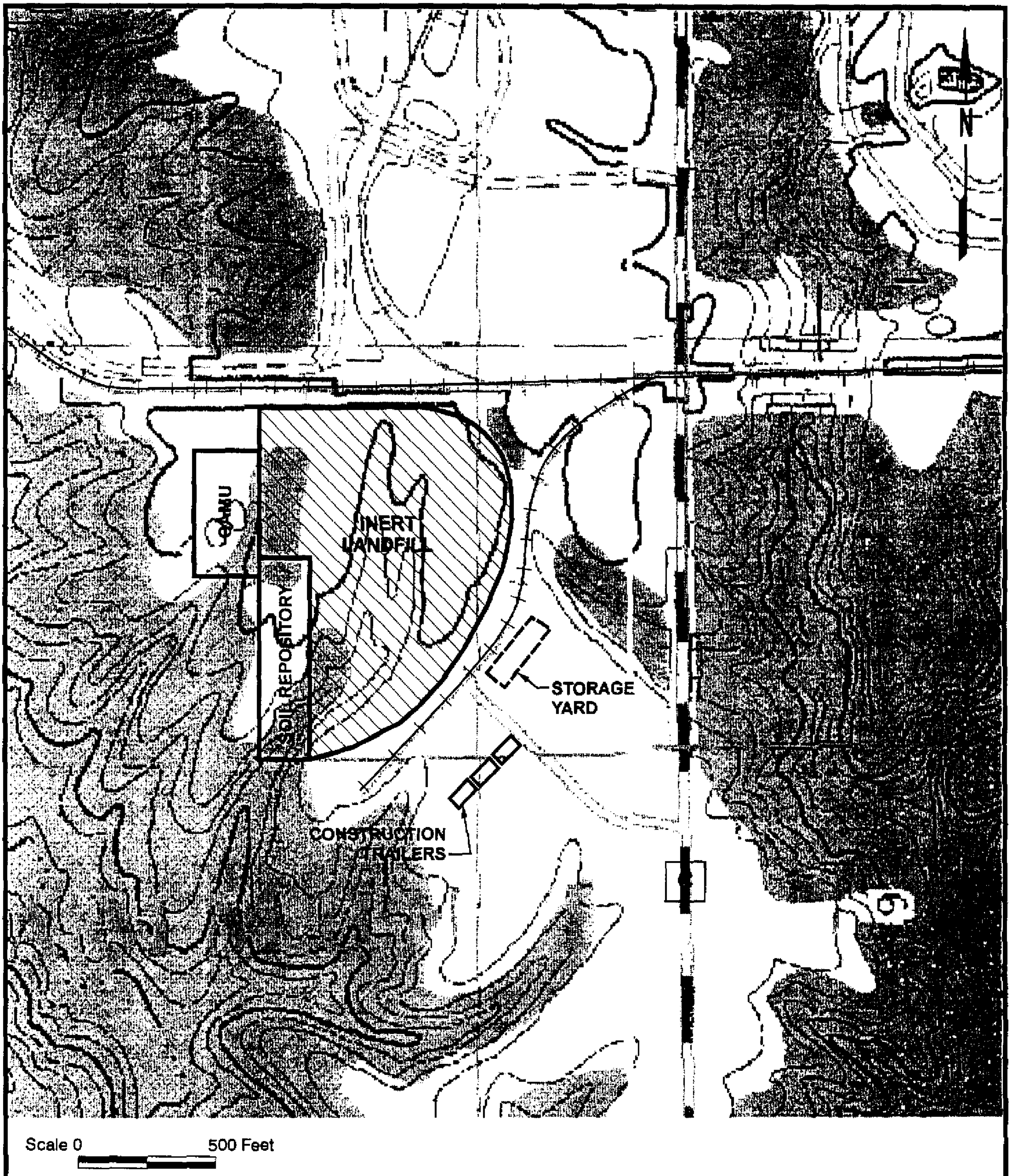

Figure 3
CAMU LOCATION
SOILS OU No.1 PROPOSED PLAN
IOWA ARMY AMMUNITION PLANT
Middletown, Iowa

HARZA Consulting Engineers and Scientists

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August, 1997. The remaining areas of soil contamination will be excavated and placed in the CAMU or in the Soil Repository according to the March 1998 Interim Action ROD. Volumes and concentrations of contaminated soil to be removed from these remaining sources are estimated based on limited site sampling. The actual volumes and characteristics will be determined based on additional confirmation sampling during the Interim Action. However, because it is anticipated that the greatest volume of soil to be treated comes from the Line 1 Impoundment and the Line 800 Lagoon, excavation of which is already completed, the total volumes and characteristics are considered representative for the purposes of this Proposed Plan.

SUMMARY OF SITE RISK

During the RI/FS, an analysis was conducted to estimate the health or environmental problems that could result if the soil contamination at IAAAP was not cleaned up. This analysis is commonly referred to as a Baseline Risk Assessment (BLRA). In conducting the BLRA, the focus was on the health effects that could result from direct exposure to contaminants as a result of the soil coming into contact with the skin, or from direct ingestion of the soil. The analysis focused on explosives, which are the major contaminants of concern. Metals and semi-volatile organic compounds (SVOCs) were also identified as contaminants of concern at certain sites. The BLRA for the IAAAP identified unacceptable risk based on a future commercial/industrial land use setting due to possible incidental ingestion and dermal contact with contaminated soils. The BLRA also identified unacceptable risk associated with potential consumption of contaminated groundwater on site. Contaminated on-site soils have been determined to be acting as a continuing source of groundwater contamination at unacceptable levels.

The BLRA provided the basis for the response actions that determined what soils were to be excavated and either disposed in the Soil Repository or the Inert Landfill or stockpiled in the CAMU for subsequent treatment. Under CERCLA, containment of low-level threats is acceptable while treatment of principal threats to permanently reduce contaminant toxicity, mobility, and volume is preferred. Principal threats are defined as the most highly contaminated, most toxic, and most mobile source materials. Under the Interim Action ROD, highly contaminated soils (cumulative risk greater than 10^{-5}) were considered to represent the principal threat and therefore were stockpiled in the CAMU for treatment at a later date. Moderately contaminated soils (cumulative risk between 10^{-5} and 10^{-6}) and lightly contaminated soils (cumulative risk less than 10^{-6}) were considered to present low-level threats and therefore were permanently disposed in the Soil Repository or the Inert Landfill cap. Potential groundwater impacts as measured by Summer's model and LDRs were also considered in identifying principal threats and low-level threats.

The BLRA presents risks associated with the "baseline" condition prior to any removal actions. For the purposes of this Proposed Plan the "baseline" conditions as defined in the BLRA no longer exist because response actions been taken or are planned to abate some of the site risks.

SCOPE AND ROLE OF ACTION

Due to the complexity of the problems associated with the IAAAP, the site has been divided into three OUs to facilitate project management. These are the:

- Soils OU (#1), to address contamination in the soils.
- Groundwater OU (#3), to address contamination of groundwater within the IAAAP boundaries and potentially off-site.
- Installation-wide OU (#4), to address closure of the CAMU, institutional controls, previously unaddressed areas of soil contamination, VOC-contaminated media, ecological risks, long-term monitoring requirements, and any other unacceptable risks which may be identified and not addressed in either OU #1 or OU #3.

OU #2 was originally established for the soils interim action, but was subsequently merged into OU #1 for simplicity and completeness.

The Removal Actions and the Interim Action for the Soils OU #1 addressed the contaminated soils in a number of areas at the IAAAP. These areas posed an unacceptable threat to human health and the environment due to risks from possible ingestion or dermal contact with soils, and due to potential contaminant leaching from soil to groundwater. Under these actions, soils contaminated at levels posing a potential health threat, or acting as a potential source of continuing groundwater contamination, were contained in on-site landfill facilities. Highly contaminated soils were stockpiled in the CAMU for subsequent treatment, while moderately and lightly contaminated soils were disposed permanently in a Soil Repository or beneath an Inert Landfill cap on site. Potential groundwater impacts as measured by Summer's model and LDRs were also considered in identifying principal threats and low-level threats. This Proposed Plan provides for treatment and ultimate disposal of the soils representing the principal threat at the IAAAP which have been stockpiled in the CAMU under the Soils OU #1. Substantial on-site activities associated with treatment will commence within 15 months of the physical completion of the interim action soil stockpiling in the CAMU. This action is intended to be the final action under the Soils OU (OU # 1) at IAAAP. Separate Proposed Plans will be issued for the Groundwater OU #3 and the Installation-wide OU #4 to provide an opportunity for the public to comment on cleanup plans under consideration for those areas.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of medium-specific goals for protecting human health and the environment. RAOs address both a contaminant level and an exposure route, because protectiveness may be achieved by reducing exposure as well as by reducing contaminant levels. The BLRA addressed this issue by identifying contaminants and exposures of concern. The interim response actions were undertaken to achieve the following objectives:

- Prevent ingestion and direct contact to contaminated soils at levels exceeding a 10^{-6} carcinogenic risk or a non-carcinogenic hazard index of one based on the reasonable maximum exposure determined in the BLRA.

- Prevent migration of explosives in contaminated soils that would result in on-site groundwater contamination in excess of HALs.

RAOs for this Proposed Plan are developed to address only those contaminated soils stockpiled within the CAMU. The following objectives are established for this Proposed Plan:

- Provide treatment to reduce the toxicity, mobility, and volume of principal threat contaminants in the CAMU in response to CERCLA's expressed preference for treatment.

- Comply with land disposal restrictions (LDRs) for disposal of treated soil. LDRs establish concentration limits or treatment requirements for land disposal of regulated materials.

- Provide long-term protection of human health and the environment.

To provide a basis for determining compliance with these objectives, chemical-specific clean up goals, or preliminary remediation goals (PRGs), have been established based on risk considerations. These PRGs are levels which are considered to be protective of individuals who may be exposed at the site. PRGs are based on potential ingestion and dermal contact with contaminated soils by the reasonably maximum exposed individual. PRGs based on these criteria are outlined in Table 1, with exceptions noted.

TABLE 1
Preliminary Soil Remediation Goals
at 10^{-6} Risk Level
Based on Ingestion/Dermal Contact

Chemical	*PRG (µg/g)*
Antimony	816
Arsenic	30.0
Beryllium	5
Cadmium	1,000
Chromium VI	10,000
Lead[1]	1000
Thallium	143
Benzo(a)anthracene	8.1
Benzo(a)pyrene	0.81
Benzo(b)fluoranthene	8.1
Dibenz(a,b)anthracene	0.81
Total PCBs[2]	10
1,3,5- Trinitrobenzene	102
2,4-Dinitrotoluene (2,4-DNT)	8.7
2,4,6-TNT	*196*[3]
RDX	*53*[3]
HMX	51,000

1. Remediation goal for lead is determined based on the "PRG Screen Model," rather than a carcinogenic risk.
2. Remediation goal for PCB is based on EPA OSWER Directive 9355.4-01, "Guidance on Remedial Actions for Superfund Sites with PCB Contamination"
3. See Table 2

In addition to risk-based soil remediation goals for protection of human health, impact to groundwater from residual soil contamination has been evaluated. The Summers' model was utilized to estimate the point at which contaminant concentrations in the soils will produce groundwater contamination at concentrations above acceptable levels. The resultant soil concentrations can then be used as a guidelines in estimating boundaries or extent of soil contamination and specifying soil cleanup goals for remediation. The Summers' model was used to determine acceptable levels for explosives COCs in soils (RDX, and 2,4,6-TNT), which are found in on-and off-site groundwater. The model was based on not exceeding groundwater concentrations of 2 ppb RDX and 2 ppb 2,4,6-TNT. The model was not used for metals as metals are relatively immobile in the clay soils found at the IAAAP. There are also no Summers' model limits for SVOCs. The site-specific PRGs for the major contributing explosives are:

TABLE 2
Preliminary Soil Remediation Goals
Based on Soil Leaching

Chemical	*PRG (μg/g)*
RDX	1.3
2,4,6-TNT	47.6

These concentrations of RDX and 2,4,6-TNT were used as PRGs in order to satisfy the RAOs for the protection of human health and the protection of groundwater. These values supersede those presented in Table 1 for RDX and TNT for unrestricted land application of treated soil.

Compliance with the stated objectives for this Proposed Plan may be achieved in one of two ways:

a. Treatment to a cummulative risk level of 10^{-6} and compliance with LDRs, followed by management of residuals in a landfill. This would result in 95% to 99+% removal of contaminants, which is consistent with CERCLA's requirement for "significant" treatment, and would be protective of groundwater.

b. Treatment to lower levels protective of groundwater (as defined by the Summers' model) followed by unrestricted land application of treatment residuals. Unrestricted land application of residuals would require a demonstration of contaminant destruction or a demonstration that residuals are not toxic or bio-available at levels that would pose a threat to human health and the environment.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA requires that each selected site remedy be protective of human health and the environment, be cost-effective, comply with other statutory laws, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. In addition, the statute includes a preference for the use of on-site treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances.

Separate alternatives were developed for soils contaminated with explosives, soils contaminated with explosives and metals, and soils contaminated with SVOCs. The Superfund program requires that the "no-action" alternative be considered as a baseline for comparison of other alternatives. The "no-action" alternative was evaluated as part of the OU #1 Interim Action, which is the precursor to this Final Action for OU # 1. Since the Final Action is intended to address treatment of the principal threat, the "no-action" alternative was not considered further.

ALTERNATIVES FOR EXPLOSIVES-CONTAMINATED SOILS

Approximately 9,000 cubic yards of soil are identified as being contaminated solely with explosives, without metals contamination. Alternatives for treating soils contaminated solely with explosives are as follows:

Alternative E1A: Incineration

This alternative consists of on-site incineration, with disposal of incinerator ash in an on-site landfill; because metals concentrations in the soils are low, it is assumed that additional treatment of incinerator ash (i.e., solidification/stabilization) will not be required. The principal elements of this alternative are as follows:

- Excavate explosives-contaminated soil from the CAMU and transport it to a temporary treatment facility on site.
- Screen, shred and blend the soil to produce a uniform feed material.
- Process the blended soil through a mobile rotary-kiln incinerator.
- Following confirmation sampling, dispose of treated soil (ash) on site in the Soil Repository or under another synthetic landfill cap.

Incineration is the primary treatment technology used under this alternative. Incineration is a thermal treatment method in which organic compounds are oxidized at elevated temperatures (combusted) and decomposed into basic products of combustion such as carbon dioxide (CO_2), water vapor, and (in some cases) inorganic gases. In most incinerator applications, an auxiliary heat source such as fossil fuel-fired burners is used to achieve the temperature necessary to evaporate water from the feed material and combust the organic compounds. Emissions from the incinerator will be controlled with proper emission control devices such as a baghouse, and by routing off-gases through an afterburner for complete combustion of gases prior to release to the atmosphere. Results from a trial burn will be used to define operating parameters for the incinerator. During a trial burn, the incinerator will be operated briefly under assumed operating conditions to monitor performance, emissions, and operational safety.

Capital costs for incineration include mobilization and project planning; site preparation; erection of a temporary shelter for stockpiled soil; conduct of a trial burn; and demobilization and site restoration. Operating costs include excavation of soils from the CAMU; incinerator operation; labor; utilities; confirmation sampling; and disposal of treated soil in the Soil Repository. Corps of Engineers program management costs are additional. For cost estimating purposes, the treatment unit is assumed to be located adjacent to the CAMU and disposal is assumed to be in the Soil Repository. Treatment capacity is assumed to be approximately 250 tons/day based on commercially available equipment, experience at other sites, and consideration of the clay soil at IAAAP. Costs for treatment of 9,000 cubic yards of explosives-contaminated soil are estimated as follows:

TABLE 3
Costs
Alternative EIA: Incineration

	Unit Rate	Cost
Capital Cost		$ 4,600,000
Operating Cost	$ 370/cy	$ 3,330,000
Subtotal		$ 7,930,000
Project Contingency	30%	$ 2,380,000
Total Project Budget		$10,310,000

This represents a present worth value of $10,310,000. Details of these cost estimates are presented in the Feasibility Study report.

Remediation could be completed in less than two months of incineration. Additional time would be required for planning, design, mobilization, conducting a trial burn and obtaining approvals, and for demobilization. These activities are expected to require approximately two additional years.

Alternative E1B: Low Temperature Thermal Desorption (LTTD)

This alternative consists of on-site LTTD, with disposal of residuals in an on-site landfill; it is assumed that additional treatment (i.e., solidification/stabilization for metals) will not be required. The principal elements of this alternative are as follows:

- Excavate explosives-contaminated soil from the CAMU and transport it to a temporary treatment facility on site.
- Screen, shred and blend the soil to produce a uniform feed material.
- Process the blended soil through a mobile direct-fired LTTD unit.
- Following confirmation sampling, dispose of treated soil on site in the Soil Repository or under another synthetic landfill cap.

LTTD is the primary treatment technology used under this alternative. LTTD treatment is similar to rotary kiln incineration except that the process operates at a lower temperature (typically 200 to 600 ^{0}F in the primary chamber, depending on the contaminants of concern). At this lower temperature, volatilization is the primary mechanism at work in the primary chamber. Organic contaminants are driven off as gases which are then destroyed at higher temperatures in the secondary chamber or afterburner. Emissions from the LTTD unit will be controlled with proper emission control devices such as a baghouse, and by routing off-gases through an afterburner for complete combustion of gases prior to release to the atmosphere. Results from treatability tests will be used to define operating parameters for the LTTD unit.

Capital costs for LTTD treatment include mobilization and project planning, site preparation, erection of a temporary shelter for stockpiled soil, conduct of treatability tests, and demobilization and site restoration. Operating costs include excavation of soils from the CAMU, LTTD operation, labor, utilities, confirmation sampling, and disposal of treated soil in the Soil Repository. Corps of Engineers program management costs are additional. For cost estimating purposes, the treatment unit is assumed to be located adjacent to the CAMU and disposal is assumed to be in the Soil Repository. Treatment capacity is assumed to be approximately 5 tons/hour based on commercially available equipment, experience with other applications, and consideration of the clay soil at IAAAP. Costs for treatment of 9,000 cubic yards of explosives-contaminated soil are estimated as follows:

TABLE 4
Costs
Alternative EIB: LTTD

	Unit Rate	Cost
Capital Cost		$ 830,000
Operating Cost	$ 300/cy	$ 2,700,000
Subtotal		$ 3,530,000
Project Contingency	30%	$ 1,060,000
Total Project Budget		$ 4,590,000

This represents a present worth value of $4,590,000. Details of these cost estimates are presented in the Feasibility Study report.

It is expected that remediation could be completed in approximately six months of LTTD operation. Additional time would be required for planning, design, mobilization, conducting treatability tests and a trial burn and obtaining approvals, and for demobilization. These activities are expected to require approximately two additional years. Treatability test results will provide a clearer indication of actual time required for LTTD treatment.

Alternative E2A: Composting

In this alternative, composting will be used to treat contaminated soils. The principal elements of this alternative are as follows:

- Excavate explosives-contaminated soil from the CAMU and transport it to a temporary treatment facility on site.
- Screen, shred and blend the soil to produce a uniform feed material.

- Process the blended soil in a temporary compost shelter by mixing with amendments such as manure, corn stalks, and food processing wastes; spreading the mixture in windrows; and turning periodically to help aerate the material and regulate temperature.

- Following confirmation sampling, dispose of treated soil on site either:

  a. in the Soil Repository or under another synthetic landfill cap, based on treatment to a cummulative risk level of 10^{-6} and compliance with LDRs, or

  b. through unrestricted land application, based on treatment to a cummulative risk level of 10^{-6}, compliance with LDRs, compliance with Summers' model requirements for protection of groundwater, and demonstration that residuals are not toxic or bio-available at levels that pose a threat to human health and the environment.

Composting is the primary treatment technology used under this alternative. Composting is a biological process in which naturally occurring micro-organisms degrade contaminants into intermediates, some of which bind to soil organic components in such a way as to reduce the mobile or extractable fraction of the contaminants. In windrow composting, contaminated soils are mixed with locally available amendments (manure, wood chips, food processing wastes, molasses, etc.) and water, then spread out in long rows. Facilities required for window composting include an asphalt pad and a temporary structure to protect the windrows from precipitation and temperature fluctuations. Conventional earth moving equipment (front end loader, dump trucks) is used to place contaminated soil and remove finished compost, while a commercially available windrow turning machine is used in the composting process. Alternatives to windrow composting include use of a mechanical agitated vessel to help aerate the material and regulate temperature, while in a static pile the soil/amendment mix is left undisturbed.

It is assumed that treated soils will be disposed of in an on-site landfill (disposal option "a" above). If composting can reliably achieve risk levels less than 10^{-6} and comply with Summers' model treatment requirements and LDRs, on-site land application of the finished compost (disposal option "b" above) may be feasible. However, additional studies of long-term stability and toxicity of compost treatment residues will be required to verify the acceptability of unrestricted land application. Because of available landfill capacity, the Army does not expect land application to provide significant cost advantages.

Capital costs for composting include mobilization and project planning; site preparation; construction of a compost shelter; and demobilization and site restoration. Operating costs include excavation of soils from the CAMU; compost facility operation; labor; compost amendments; utilities; confirmation sampling; and disposal of treated soil in the Soil Repository. For cost estimating purposes, the treatment unit is assumed to be located adjacent to the CAMU and disposal is assumed to be in the Soil Repository. Corps of Engineers program management costs are additional. A treatment cycle of approximately 30 days per batch is assumed as a year-round average, allowing 5 days for loading, 20 days for composting, and 5 days for unloading. Costs for treatment of 9,000 cubic yards of explosives-contaminated soil are estimated as follows:

TABLE 5
Costs
Alternative E2A: Composting

	Unit Rate	Cost
Capital Cost		$ 1,050,000
Operating Cost	$260 - $360/cy	$ 2,340,000 - $ 3,240,000
Subtotal		$ 3,390,000 - $ 4,290,000
Project Contingency	30%	$ 1,020,000 - $ 1,290,000
Total		$ 4,410,000 - $ 5,580,000

This represents a present worth value of $ 4,410,000 - $ 5,580,000. The variation in estimated operating costs indicates the potential range of amendment requirements and costs. Details of these cost estimates are presented in the Feasibility Study report.

It is expected that remediation could be completed in approximately one year of compost facility operation. Additional time would be required for planning, design, mobilization, process optimization testing, and demobilization.

Alternative E2B: Bio-Slurry Treatment

In this alternative, either aerobic/anoxic or anaerobic bio-slurry treatment will be used to treat contaminated soils. The principal elements of this alternative are as follows:

- Excavate explosives-contaminated soil from the CAMU and transport it to a temporary treatment facility on site.
- Screen, shred and blend the soil to produce a uniform feed material.
- Process the blended soil in a bio-slurry treatment facility.
- Following confirmation sampling, dispose of treated soil on site either:

    a. by dewatering and disposal in the Soil Repository or under another synthetic landfill cap, based on treatment to a cummulative risk level of 10^{-6} and compliance with LDRs, or

    b. through unrestricted land application of the treated liquid slurry, based on treatment to a cummulative risk level of 10^{-6}, compliance with LDRs, compliance with Summers' model requirements for protection of groundwater, and demonstration that residuals are not toxic or bio-available at levels that pose a threat to human health and the environment.

- If disposal option "a" is selected, an additional treatment process will be required for treatment of slurry water following solids dewatering and prior to disposal.

Bio-slurry treatment is the primary treatment technology used under this alternative. Bio-slurry treatment uses naturally occuring micro-organisms to degrade contaminants. The process involves blending contaminated soils with water to produce a slurry of between 15 and 40 % solids, adding nutrients and co-substrates (such as molasses), and mixing. Processes may use either aerobic/anoxic regimes and anaerobic regimes. In aerobic/anoxic processes, blowers cycle on and off to alternate between aerobic (oxygenated) and anoxic (oxygen-starved) conditions, while mechanical mixers maintain solids in suspension. In anaerobic processes, no aeration is provided and anaerobic conditions are maintained; mechanical mixers again maintain solids in suspension.

It is assumed that thickening and dewatering will be required prior to disposal in an on-site landfill (disposal option "a" above). If bio-slurry treatment can reliably achieve risk levels less than 10^{-6} and comply with Summers' model treatment requirements and LDRs, on-site land application of the liquid slurry (disposal option "b" above) may be feasible. However, additional studies of long-term stability and toxicity of treatment residues will be required to verify the acceptability of unrestricted land application. Because of available landfill capacity, the Army does not expect land application to provide significant cost advantages.

Capital costs for bio-slurry treatment include mobilization and project planning; site preparation; construction of a treatment facility including three 250,000 gallon treatment tanks, solids dewatering facilities (assumed to be precoat rotary drum vacuum filters), an equipment building, and associated equipment; and demobilization and site restoration. Operating costs include excavation of soils from the CAMU; treatment facility operation; labor; chemicals; utilities; confirmation sampling; and disposal of treated soil in the Soil Repository. Corps of Engineers program management costs are additional. For cost estimating purposes, the treatment unit is assumed to be located adjacent to the CAMU and disposal is assumed to be in the Soil Repository. A treatment cycle of approximately 10 weeks per batch is assumed as a year-round average. With two tanks processing at all times, this allows an additional one week for loading and three weeks for unloading and dewatering. Land application of the treated liquid slurry would require a longer treatment cycle (assumed to be approximately 18 weeks). Costs for treatment of 9,000 cubic yards of explosives-contaminated soil are estimated as follows:

transportation and disposal. These costs assume disposal as a hazardous waste based on exceedence of TCLP regulatory limits under RCRA. Off-site disposal facilities must be in permitted under RCRA and operating in compliance with permit conditions, based on CERCLA Off-site Policy (NCP 300.440).

ALTERNATIVES FOR SVOC-CONTAMINATED SOILS

Approximately 200 cubic yards of soil are identified as being contaminated with SVOCs. Alternatives for treating these soils are the same as presented above for soil contaminated solely with explosives:

Alternative S1A: Incineration

This alternative consists of on-site incineration, with disposal of incinerator ash in an on-site landfill. Capital costs for incineration are assumed to be covered under alternative E1A for explosives-contaminated soils. Operating costs are estimated at $370 per cubic yard. Therefore, the incremental cost for treatment of approximately 200 cubic yards of SVOC-contaminated soil is estimated at approximately $74,000. Incineration of SVOC-contaminated soils is expected to add only a couple of days to the remediation time.

Alternative S1B: Low Temperature Thermal Desorption (LTTD)

This alternative consists of on-site low temperature thermal desorption (LTTD), with disposal of residuals in an on-site landfill. Capital costs for LTTD treatment are assumed to be covered under alternative E1B for explosives-contaminated soils. Operating costs are estimated at $300 per cubic yard. Therefore, the incremental cost for treatment of approximately 200 cubic yards of SVOC-contaminated soil is estimated at approximately $60,000. LTTD treatment of SVOC-contaminated soils would add less than a week to the remediation time.

Alternative S2A: Composting

This alternative consists of on-site composting, with disposal of residuals in an on-site landfill. Capital costs for compost treatment are assumed to be covered under alternative E2A for explosives-contaminated soils. Operating costs are estimated at $260 to $360 per cubic yard. Therefore, the incremental cost for treatment of approximately 200 cubic yards of SVOC-contaminated soil is estimated at approximately $52,000 to $72,000. Composting of SVOC-contaminated soils would add roughly two weeks to the overall remediation requirement.

Alternative S2B: Bio-slurry Treatment

This alternative consists of on-site bio-slurry treatment, with disposal of residuals in an on-site landfill. Capital costs for bio-slurry treatment are assumed to be covered under alternative E2B for explosives-contaminated soils. Operating costs are estimated at $300 to $440 per cubic yard. Therefore, the incremental cost for treatment of approximately 200 cubic yards of SVOC-contaminated soil is estimated at approximately $60,000 to $88,000. Bio-slurry treatment of SVOC-contaminated soils would add roughly one batch to the overall remediation requirement. This is not expected to have a significant impact on the overall remediation schedule.

Alternative S3: Off-Site Disposal

Under this alternative, soil contaminated with SVOCs will be excavated from the CAMU and transported to a commercial waste treatment and disposal facility off-site. Since sampling data does not exceed hazardous waste criteria, it is assumed that these soils can be disposed of as non-hazardous waste. Capital costs are assumed to be covered under alternatives E1A, E1B, E2A, and E2B. Operating costs are estimated at $30,000 to $70,000 depending on unit prices charged by commercial waste disposal operators for transportation and disposal.

EVALUATION OF ALTERNATIVES

In accordance with Superfund guidance, each alternative is assessed against the following evaluation criteria:

- Overall Protection of Human Health and the Environment: Describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): Describes how the alternative complies with ARARs or, if a waiver is required, how it is justified; also addresses other information from advisories, criteria, and guidance "to be considered".

- Long-Term Effectiveness and Permanence: Evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.

- Reduction of Toxicity, Mobility, and Volume Through Treatment: Evaluates the anticipated performance of the specific treatment technologies an alternative may employ.

- Short-Term Effectiveness: Examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met.

- Implementability: Evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.

- Cost: Evaluates the capital and operation and maintenance (O&M) costs of each alternative.

- State Acceptance: Reflects the state's apparent preferences among or concerns about the alternatives.

- Community Acceptance: Reflects the community's apparent preferences among or concerns about alternatives.

The analysis of alternatives is arranged by type of contaminant: explosives, explosives plus metals, SVOCs.

EVALUATION OF ALTERNATIVES FOR EXPLOSIVES-CONTAMINATED SOILS

Overall Protection of Human Health and the Environment: Since both Thermal Treatment (incineration and LTTD) and Biological Treatment (composting and bio-slurry treatment) provide for destruction/degradation of contaminants to acceptable risk levels and the management of residuals (either through landfilling or treatment to lower levels protective of groundwater), both categories of alternatives are considered equally protective of human health and the environment.

Compliance with ARARs: Most ARARs issues will be comparable for both Thermal Treatment and Biological Treatment, although Thermal Treatment will involve more concerns related to air emissions (i.e., ambient air quality standards, visible emission standards, emission standards for particulate matter) and compliance with EPA's requirement for a combustion facility risk assessment.

Long-Term Effectiveness and Permanence: Thermal Treatment will permanently destroy explosives contaminants that are present above PRGs, while Biological Treatment will degrade and stabilize them. Both of these processes are considered irreversible. While composting has been conducted on a scale similar to that required at IAAAP, long-term effectiveness of Biological Treatment is difficult to assess because of uncertainties about the degree of treatment that can be achieved and the bio-availability of treatment residuals. Thermal Treatment may be considered more effective since destruction of contaminants is more complete. However, long-term landfill operation and maintenance is required under either alternative unless Biological Treatment is determined to be acceptable for unrestricted land application.

Reduction of Toxicity, Mobility, and Volume Through Treatment: Both Thermal Treatment and Biological Treatment will reduce contaminant levels to below PRGs, although Thermal Treatment will provide a greater degree of reduction in contaminant toxicity and mobility. Incineration will result in some volume reduction, while composting will result in a volume increase. LTTD and bio-slurry treatment are not expected to change soil volumes significantly as a result of treatment.

Short-Term Effectiveness: While explosives hazard assessments and control measures will be required under both Thermal and Biological Treatment, the requirements for Thermal Treatment are expected to be more rigorous than for Biological Treatment. A combustion risk assessment will demonstrate that risks associated with Thermal Treatment can be managed effectively. Other short-term effectiveness issues are considered to be equivalent.

Implementability: Both Thermal Treatment and Biological Treatment involve a number of implementability issues. Both use commercially available equipment. Testing will be required for each alternative prior to implementation: incineration and LTTD will require a trial burn; LTTD has not been utilized for remediation of explosives-contaminated soils in this country and testing will, therefore, be required to demonstrate its effectiveness; although testing has been done to demonstrate the effectiveness of composting and bioslurry treatment, additional testing will be required to define process and operating parameters. Once approvals are received and equipment is mobilized, Thermal Treatment can be accomplished in a few months while Biological Treatment will require several years.

Cost: The costs of Thermal and Biological Treatment may be compared as follows:

TABLE 7
Alternative Cost Comparisons
Explosives

Alternative	Capital Cost	Operating Cost	Present Worth (incl. contingency)
E1A: Incineration	$ 4,600,000	$ 3,330,000	$10,310,000
E1B: LTTD	$ 830,000	$ 2,700,000	$ 4,590,000
E2A: Composting	$ 1,050,000	$ 3,390,000 - $4,290,000	$4,410,000 - $5,580,000
E2B: Bio-slurry	$ 1,950,000	$ 2,700,000 - $3,960,000	$5,740,000 - $7,070,000

Corps of Engineers program management costs are not included in the above costs.

Operating costs of each alternative may be influenced significantly by variables that are difficult to predict at this time. Operating efficiencies (including cycle times, labor costs, energy costs, and amendment mixes and costs) may vary considerably for any of these processes, depending on the physical characteristics of the soil, weather, treatability of the contaminants, and individual contractor capabilities. Previous studies at IAAAP included an evaluation of Thermal and Biological Treatment alternatives considering the impact of varying volumes of contaminated soil. Although total costs were significantly influenced by soil volumes, the relative positioning of the alternatives were not affected. If further investigations demonstrate that LTTD can achieve PRGs, it appears to be the least costly alternative. However, with favorable amendment requirements and costs, composting and bio-slurry treatment may be competitive with LTTD. Incineration is considerably more costly.

State and Community Acceptance: State and community acceptance will be addressed in the ROD once comments on the RI/FS report and Proposed Plan have been received.

Summary: In summary, Biological Treatment (i.e., composting) may be cost competitive with Thermal Treatment (i.e., LTTD) or may cost up to a million dollars (roughly 20%) more. In other criteria one alternative or the other may offer specific advantages, but both comply with RAOs and on balance are considered equivalent.

EVALUATION OF ALTERNATIVES FOR EXPLOSIVES PLUS METALS CONTAMINATED SOILS

Overall Protection of Human Health and the Environment: Since Alternative M1 (Explosives Treatment Followed by Stabilization), Alternative M2 (Solidification/Stabilization With Activated Carbon), and Alternative M3 (Off-site Disposal) all provide for destruction/degradation, immobilization, and/or containment of contaminants, all three alternatives are considered equally protective of human health and the environment.

Compliance with ARARs: Thermal Treatment under Alternative M1 would involve more concerns related to air emissions and compliance with EPA's requirement for a combustion facility risk assessment.. ARARs are not a part of off-site alternatives. Off-site alternatives must meet conditions specified in the off-site facility's permit.

Long-Term Effectiveness and Permanence: The long-term effectiveness of Alternative M1 will depend on the process selected for explosives treatment as discussed above for Explosives-Contaminated Soils. Both Alternatives M2 and M3 stabilize contaminants rather than degrading them, and both require long-term landfill operation and maintenance to ensure continued effectiveness.

Reduction of Toxicity, Mobility, and Volume Through Treatment: Alternative M1 would provide reduction in both contaminant toxicity and mobility through destruction or degradation of explosives and solidification/stabilization of metals. Alternatives M2 and M3 would provide reduction in contaminant mobility only. Contaminant volume is not expected to be reduced significantly under any of the alternatives.

Short-Term Effectiveness: Short-term effectiveness would be comparable for all three alternatives, although Thermal Treatment under Alternative M1 would involve more rigorous explosives hazard assessments and control measures.

Implementability: Off-Site Disposal (Alternative M3) would be the easiest alternative to implement. Process development testing would be required for Explosives Treatment Followed by Stabilization (Alternative M1) and for Solidification/Stabilization With Activated Carbon (Alternative M2). In addition, the presence of metals may interfere with the implementability of Biological Treatment under Alternative M1.

Costs: Costs may be compared as follows:

TABLE 8
Alternative Cost Comparisons
Explosives Plus Metals

Alternative	Incremental Cost
M1: Explosives Treatment Followed by Stabilization	$250,000 to $350,000
M2: Solidification/Stabilization With Activated Carbon	$130,000 to $230,000
M3: Off-Site Disposal	$600,000 to $1,000,000

State and Community Acceptance: State and community acceptance will be addressed in the ROD once comments on the RI/FS report and Proposed Plan have been received.

EVALUATION OF ALTERNATIVES FOR SVOC-CONTAMINATED SOILS

Overall Protection of Human Health and the Environment: The overall protection provided by Biological Treatment is difficult to assess because of uncertainties about its effectiveness for the specific SVOCs of concern. The remaining alternatives (Thermal Treatment and Off-site Disposal) are considered equally protective of human health and the environment.

Compliance with ARARs: Thermal Treatment would involve more concerns related to air emissions and compliance with EPA's requirement for a combustion facility risk assessment.. ARARs are not a part of off-site alts. Off-site alts must meet conditions specified in the off-site facilities' permit.

Long-Term Effectiveness and Permanence: Thermal Treatment will permanently destroy contaminants that are present above PRGs. The effectiveness of Biological Treatment is difficult to assess because of uncertainties about abilty to treat the specific SVOCs of concern. Off-Site Disposal contains contaminants rather than degrading them, and requires long-term landfill operation and maintenance to ensure continued effectiveness.

Reduction of Toxicity, Mobility, and Volume Through Treatment: Thermal Treatment provides reduction in both contaminant toxicity and mobility through destruction of contaminants. The reduction provided by Biological Treatment is difficult to assess because of uncertainties about abilty to treat the specific SVOCs of concern. Off-Site Disposal provides reduction in contaminant mobility only. Incineration will result in some volume reduction, while composting will result in a volume increase. LTTD, bio-slurry treatment, and off-site disposal are not expected to change soil volumes significantly.

Short-Term Effectiveness: Short-term effectiveness will be comparable for all three alternatives, although Thermal Treatment will involve more rigorous explosives hazard assessments and control measures.

Implementability: Off-Site Disposal will be the easiest alternative to implement. Process development testing will be required for Biological Treatment, and trial burns will be required for Thermal Treatment.

Costs: Costs may be compared as follows:

TABLE 9
Alternative Cost Comparisons
SVOCs

Alternative	Incremental Cost
S1A: Incineration	$74,000
S1B: LTTD	$60,000
S2A: Composting	$52,000 to $72,000
S2B: Bio-slurry	$50,000 to $72,000
S3: Off-Site Disposal	$30,000 to $70,000

State and Community Acceptance: State and community acceptance will be addressed in the ROD once comments on the RI/FS report and Proposed Plan have been received.

PREFERRED ALTERNATIVE

Based on an evaluation of the various alternatives, the Army and EPA conclude that Biological Treatment (Alternatives E2A and E2B) and LTTD Thermal Treatment (Alternative E1B) are capable of achieving RAOs by providing treatment to reduce the toxicity, mobility, and volume of principal threat contaminants in the CAMU in response to CERCLA's expressed preference for treatment, complying with land disposal restrictions (LDRs) for disposal of treated soil, and providing long-term protection of human health and the environment.

LTTD Thermal Treatment is the preferred remedy for explosives-contaminated soils, with Biogical Treatment as the contingency remedy pending results of feasibility testing and field demonstrations. Additional process development and economic evaluations will be conducted to further define the performance and cost of each alternative. In addition, a combustion facility risk assessment will be conducted consistent with EPA policies and guidance prior to implementation of LTTD Thermal Treatment. The results of this risk assessment will be presented to the public with an opportunity to comment prior to commencing the site work. If the risk assessment shows that LTTD Thermal

Treatment cannot be conducted in a protective manner, the contingency remedy will be implemented.

Solidification/Stabilization With Activated Carbon (Alternative M2) is the preferred remedy for soils contaminated with explosives plus metals, and Off-Site Disposal (Alternative S3) is the preferred remedy for soils contaminated with SVOCs. These alternatives comply with RAOs at a lower cost than other alternatives and are equivalent to or better than other alternatives in most of the remaining criteria.

The Army and EPA believe the preferred alternative will be protective of human health and the environment, will comply with ARARs, will be cost effective, and will utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedy will also meet the statutory preference for the use of treatment as a principal element to the maximum extent practicable. Therefore, the preferred alternative provides the best balance of trade-offs among the alternatives with respect to the evaluating criteria.

ACRONYMS

ATL	Alternate Treatment Level
ARAR	Applicable or Relevant and Appropriate Requirement
BDAT	Best Demonstrated Available Technology
CAA	Clean Air Act
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
2,4-DNT	2,4-Dinitrotoluene
EPA	U.S. Environmental Protection Agency
g	Grams
g/dscm	Grams Per Dry Cubic Meter at Standard Conditions
g/dscf	Grams Per Dry Cubic Feet at Standard Conditions
HAL	Health Advisory Level
IAAAP	Iowa Army Ammunition Plant
I.A.C.	Iowa Administrative Code
IDNR	Iowa Department of Natural Resources
IEQA	Iowa Environmental Quality Act
kg	Kilogram
LDR	Land Disposal Restriction
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
Mg/yr	Megagrams Per Year
mrem	Millirems
MSWLF	Municipal Solid Waste Landfill
NAAQS	National Ambient Air Quality Standard
NCP	National Contingency Plan
NESHAP	National Emission Standard for Hazardous Air Pollutant
NPDES	National Pollutant Discharge Elimination System
NRL	Negligible Risk Level
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
pCi/L	Pico Curies Per Liter
pH	Unit of Measure for Hydrogen Ion Concentration
PM_{10}	Particulate Matter (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers)
ppm	Parts Per Million
RCRA	Resource Conservation and Recovery Act
RDX	1,3,5-Trinitro-1,3,5-triazacyclohexane
SDWA	Safe Drinking Water Act

SVOC SemiVolatile

SWMU	Solid Waste Management Unit
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
1,3,5-TNB	1,3,5-Trinitrobenzene
TNT	Trinitrotoluene
2,4,6-TNT	2,4,6-Trinitrotoluene
TSCA	Toxic Substances Control Act
T/S/D	Treatment/Storage/Disposal
U.S.C.	United States Code
UST	Underground Storage Tank
$\mu g/m^3$	Micrograms Per Cubic Meter