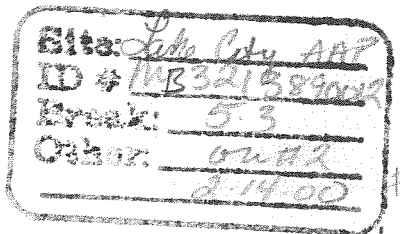
Evelyn Vangoethem
02/14/00 09:36 AM

To: Melissa Yocum/PLMG/R7/USEPA/US@EPA

cc:
Subject: FOIA 382



96410

Melissa,

I need copies of the following:

ROD for Lake City Army Ammunition Plant (NW Lagoon) OU2, signed 4-22-99 (MO3213890012) could not find

ROD for Ogallala GW Contamination, OU1, dated 4-23-99 (NED986369247)

ROD for Ace Services, OU1, dated 5-5-99 (KSD046746731)

ESD for Des Moines TCE, OU4, dated 7-15-99 (IAD980687933)

EST for Des Moines TCE, OU2, dated 7-15-99 (IAD980687933)

I need by COB Friday, Feb. 18.

Questions - 7659

Thanks!

Evelyn

copy for file attached!
Evelyn
7659

96410

Final

Record of Decision for Remedial Action at Area 18 Operable Unit Lake City Army Ammunition Plant Independence, Missouri

Prepared for

Lake City Army Ammunition Plant

FEBRUARY 1998

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 DECLARATION FOR THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

- Area 18 Operable Unit (OU), Lake City Army Ammunition Plant (LCAAP), National Priorities List (NPL) Site.
- Independence, Jackson County, Missouri.

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document describes the selected remedial action for the LCAAP Area 18 OU, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on the contents of the Administrative Record for Area 18 OU, LCAAP. The U. S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR) concur with the selected alternative.

1.3 ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the Area 18 OU, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

1.4 SITE DESCRIPTION

Three operable units have been identified at LCAAP. The three operable units are:

- The Area 18 OU (the subject of this ROD) is an 88-acre area located along the northern portion of the installation and comprises earth pits used as disposal areas.

- The Northeast Corner Operable Unit (NECOU) is a 190-acre area comprising solid waste disposal areas and burning areas. The NECOU is currently at the feasibility study stage.

- The Installation-Wide Operable Unit (IWOU) comprises a variety of disposal areas found throughout the facility. This OU is currently in the remedial investigation (RI) stage.

This ROD is for the remedial action at the Area 18 OU and is the first ROD for LCAAP.

1.5 DESCRIPTION OF SELECTED REMEDY

The selected alternative for the Area 18 OU, Soil Vapor Extraction and Excavation in combination with Ground Water Extraction and Treatment, includes the following major components:

- Soil vapor extraction using a multi-phase extraction system and treatment of extracted ground water and vapors to address VOC (volatile organic compound)-contaminated soil and shallow ground water in source areas.
- Excavation and disposal of lead-contaminated soil.
- Ground water extraction and treatment.
- Institutional controls to limit future site use.
- Long-term monitoring.

The selected remedial action uses treatment to address the principal threat wastes (VOCs) in the soil in the pits and excavation and/or containment to address low level threat wastes (lead) in the surface soil at Area 18. The selected remedy also uses extraction and treatment to address contaminants in the ground water. Institutional controls will be used for short-term and long-term management and to prevent exposure to both principal and low level threat wastes and affected ground water.

1.6 STATUTORY DETERMINATION

The selected remedy is protective of human health and the environment, complies with Federal and State of Missouri requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the Area 18 OU. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the selected remedy continues to provide adequate protection of human health and the environment.

1.7 SIGNATURE AND AGENCY CONCURRENCE ON THE REMEDY

Richard R. Thibodeau — March 5, 1998
Richard R. Thibodeau
Lieutenant Colonel, OD
Commander, Lake City AAP
Date

J.C. Menig — 30 April 1998
J.C. Menig
Deputy Assistant Chief of Staff
for Installation Management
U.S. Army
Date

Dennis Grams — April 22, 1999
Dennis Grams, P.E.
Regional Administrator
U.S. Environmental Protection Agency Region 7
Date

Reviewed and Concurred:

Installation Remedial Project Manager — Date: March 5, 1998

Major Subordinate Command DERP PM — Date: 9 Mar 1998

Installation/Major Subordinate Command Legal Advisor — Date: 5 Mar 1998

2.0 DECISION SUMMARY

2.1 SITE NAME AND LOCATION

LCAAP is a 3,935 acre facility in Jackson County, Missouri, mostly within the corporate boundary of Independence, Missouri (Figure 1). The Area 18 OU is approximately 88 acres and is in the north-central portion of the Installation (Figure 2). The unincorporated village of Lake City is situated near the north central plant boundary, approximately 3,000 feet northwest of the Area 18 OU.

2.2 AREA 18 OU DESCRIPTION/HISTORY AND REGULATORY OVERSIGHT ACTIVITIES

2.2.1 LCAAP Description/History

LCAAP was established in the early 1940s and was the first government-owned facility constructed to expand small arms ammunition production. Construction at the facility began on 26 December 1940 and was completed on 11 October 1941. The Plant has operated continuously since 1941, except for a 5-year period between World War II and the Korean Conflict. The operating contractor from 1941 to 1985 was Remington Arms. Olin Corporation became the operating contractor in November 1985 and continues to operate the plant on behalf of the Army.

2.2.2 Area 18 OU Site Description/History

Area 18 OU is located in the north central portion of LCAAP along the Installation boundary. Adjacent land use includes a mix of residential, agricultural, and industrial uses. The land surface is relatively flat across the OU. Figure 3 shows a site map of Area 18 including nearby residences to the northwest.

The geology of Area 18 is typically river-deposited sediments that have filled an ancient river channel (paleochannel), with finer sediments (silts and clays) in the upper layers and coarser sediments (sands and gravels) in deeper layers. Bedrock lies below the sediments at a depth ranging from approximately 50 feet to 90 feet below ground surface (bgs).

Surface water runoff from Area 18 generally ponds in low-lying, flat, and poorly drained fields. Two surface water ditches, Ditches B and B1, cross Area 18 and converge before exiting the Installation to the north (Figure 3). At times, there may be seasonal discharge of shallow ground water to the surface drainages.

The average depth to shallow ground water in the vicinity of Area 18 is 5 to 7 feet below ground surface with an average seasonal fluctuation of 4 to 7 ft. The shallow ground water is not used in the Area 18 vicinity. The primary aquifer at Area 18 (and the surrounding area) is in the sand and gravel layers beginning at depths between 25 feet and 40 feet below ground surface. This aquifer provides production water and drinking water to the Installation as well as drinking water to nearby residents who have private domestic wells.

There are no buildings or structures in Area 18 except for the Area 18 ground water treatment plant. The treatment plant was completed in 1996 and is currently operating. An extraction well (EW-1) was also constructed in 1996 to contain ground water contamination. EW-1 is located just north of the waste areas described below (Figure 4). A water supply well, 17-FF, is located directly west of Area 18. It was one of 14 wells used to supply process and drinking water to the Installation. Well 17-FF is currently connected to the ground water treatment plant and, with well EW-1, serves to contain the VOC-contaminated ground water in the Area 18 OU.

A review of aerial photographs and historical records showed that waste disposal activities occurred in the Area 18 OU for 20 years or more, between the early 1950s and the mid-1970s. The following wastes were disposed of at several areas within the Area 18 OU:

- Industrial Wastewater Treatment Plant (IWTP) Waste
- Oil and Grease
- Solvents
- Plant Trash
- Demolition Waste

These disposal areas were covered with soil in the early 1980s. A RI was performed at the Area 18 OU in 1993 to locate, define, and investigate potential disposal areas. Data collected during the RI indicated that soil and ground water in this area contained contaminants consistent with the types of wastes disposed of onsite.

Six Areas of Concern (AOCs) were identified during the Area 18 RI. The locations of the AOCs are illustrated in Figure 4. During the RI, soil and ground water samples were collected from each AOC and analyzed at a laboratory to determine the chemicals present. The AOCs were then categorized based on the types of contaminants present in the soil and ground water in each area. They are defined as follows:

- AOC 1 Solid Waste Management Unit (SWMU), encompassing a relict lagoon identified as 57-L1-69, contaminated with VOCs.

- AOC 2 SWMU, encompassing approximately 5 relict lagoons, contaminated with VOCs.

- AOC 3 SWMU, encompassing a relict lagoon identified as 69-L6-75, contaminated with VOCs.

- AOC 4 Western area of surface soil (the upper 2 feet of the soil profile) containing lead (at concentrations greater than 1,000 ppm).

- AOC 5 Eastern area of surface soil containing lead (at concentrations greater than 1,000 ppm).

- AOC 6 Area containing concentrations of copper, mercury, and zinc determined to present a human health risk through ingestion of beef from cattle that grazed at Area 18. AOC 6 encompasses all the other five AOCs.

2.2.3 Regulatory Oversight Activities

LCAAP was proposed for listing on EPA's National Priorities List (NPL) in October 1984 with final listing in July 1987, effective August 1987. The site is jointly regulated by the EPA and the MDNR. The Army, EPA, and MDNR signed a Federal Facility Agreement (FFA) that became effective November 28, 1989, which defines the procedural framework under which LCAAP sites will be investigated and remediated, and the roles and responsibilities of the Army, EPA, and the State of Missouri regarding CERCLA response activities at the site.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Community relations activities that have taken place at LCAAP to date include:

- **FFA process** - After preparation of the FFA by the U. S. Army, EPA, and MDNR, the document was published for public review and comment. The FFA became effective November 1989.

- **Administrative Record** - Consistent with requirements of CERCLA section 113(k), an Administrative Record for information associated with CERCLA cleanup activities at LCAAP was established in Building 3 at LCAAP. The Administrative Record contains information used to support LCAAP decision-making associated with CERCLA issues. All documents in the Administrative Record are available to the public.

- **Information repositories** - The Administrative Record is located at the Mid-Continent Public Library, Blue Springs South Branch (public repository), and the West Gate (Building 6) at LCAAP.

- **Community Relations Plan (CRP)** - The CRP was prepared pursuant to requirements in the LCAAP FFA and is being actively implemented. This plan was updated in 1996.

- **Restoration Advisory Board (RAB)** - The RAB has been formed to facilitate public input in the CERCLA cleanup at LCAAP, and meets bi-monthly. In addition to U.S. Army, EPA, and State of Missouri personnel, the RAB includes community leaders and representatives from the surrounding area.

- **Mailing list** - A mailing list of all interested parties in the community is maintained by LCAAP and updated regularly.

- **Fact sheet** - A fact sheet describing the status of the Installation Restoration Program (IRP) was last distributed to the mailing list addressees in November 1996.

- **Proposed Plan** - The Proposed Plan on this action was distributed to the mailing list addressees for their comments.

The Remedial Investigation/Feasibility Study (RI/FS) and Proposed Plan for the LCAAP Area 18 OU were released to the public on April 14, 1997. These documents were made available to the public in both the Administrative Record at the LCAAP and in the site Information Repository noted above. The notice of availability for these documents was published in the Independence and Blue Springs Examiner on April 12 and 13, 1997. A public comment period was held from April 14 to May 14, 1997. In addition, a public meeting was held on April 22, 1997 where representatives from LCAAP, EPA, and MDNR were available to answer questions and accept comments regarding the remedial action under consideration. The public was given the opportunity to make comments on the proposed action at Area 18. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD.

This ROD is based on the contents of the Administrative Record for Area 18 OU, in accordance with CERCLA, as amended by SARA, and the NCP. The RI/FS reports and the Proposed Plan for Area 18 OU provide information about Area 18 OU and the selected remedy. These documents are available at the Information Repositories at LCAAP (West Gate, Building 6) and the Mid-Continent Public Library, Blue Springs, South Branch.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the environmental problems at LCAAP are complex. As a result, the FFA parties have organized the work into three site-specific OUs. The operable units are identified as follows:

- The Area 18 OU is located along the northern portion of the installation and comprises surface impoundments used as disposal areas.

- The NECOU is a 190-acre area comprising solid waste disposal areas and burning areas. The NECOU is currently at the feasibility study stage.

- The IWOU comprises a variety of disposal areas located throughout the facility. This OU is currently in the RI stage.

This ROD address problems at Area 18. The primary problem at Area 18 is contaminated ground water. The ground water contains chemicals above regulatory standards and poses a potential threat to onsite personnel who use the ground water as well as offsite residents who could potentially be impacted if the contaminated ground water moves offsite. The sources of chemicals in the ground water at Area 18 are the pits that were used in the past to dispose of various plant wastes including solvents and hydrocarbons. The disposal pits are contributing chemicals to the ground water and will continue to do so unless addressed. An additional problem at Area 18 is the presence of metals in the surface soil.

The Army performed an Engineering Evaluation/Cost Analysis (EE/CA) in November 1994 to develop removal action alternatives that would contain ground water contamination at the Area 18 OU before it reached the Installation boundary. The EE/CA was conducted to expedite response actions at Area 18. The Area 18 OU FS was conducted concurrently to develop and evaluate remedial alternatives for both soil and ground water.

A public meeting was held in January 1995 to present the removal action alternatives developed in the EE/CA. The preferred ground water removal action alterative identified in the Area 18 OU EE/CA was documented in a June 1995 Action Memorandum. The removal action is a ground water removal and treatment process and is currently operating. This removal action is consistent with the selected ground water remedy presented in this ROD and includes the following major components:

- Extraction of ground water from existing well 17-FF and new extraction well EW-1.
- Treatment of extracted ground water using an air stripper system.
- Treatment of off-gas from the air stripper using a catalytic oxidation unit.
- Discharge of the treated effluent to the Little Blue Valley Sewer District.

The remedial action for Area 18 will address ground water contamination at Area 18 using ground water wells to extract and a treatment system to treat affected ground water. The ground water extraction system will also prevent offsite migration of affected ground water until treatment is completed. The selected remedial action also uses treatment to address source area soils (disposal pits) to reduce their potential to provide a source of chemicals to the ground water. Metals in the surface soil will be addressed by excavation, containment, and/or institutional controls.

Combined with the response actions for the other two OUs, the selected remedy for Area 18 will provide a comprehensive solution for environmental problems throughout LCAAP.

2.5 SITE CHARACTERISTICS

The primary sources of contamination at Area 18 are the solvent disposal pits (AOC 1, 2, and 3) identified on Figure 4. VOCs from solvents disposed of in the pits are leaching into the ground water resulting in chemical concentrations of VOCs in ground water at levels above Maximum Contaminant Levels (MCLs). Figure 5 identifies the areal extent of known ground water contamination at Area 18. Onsite workers and nearby residents in the community of Lake City (Figure 2) could potentially be affected by contaminants in both the soil and ground water.

In addition, lead and other metals (copper, mercury, and zinc) resulting from past disposal activities are present in the surface soil. AOC-6 represents the area affected by metals concentrations above remediation goals (RGs) and is identified on Figure 4. Lead was identified in surface soil at concentrations above RGs in AOCs 4 and 5, within the larger AOC-6 area. Other metals besides lead (copper, mercury, and zinc) are present above RGs throughout AOC-6.

This section describes the presence and distribution of contaminants at Area 18 resulting from past activities.

2.5.1 Soil

VOCs were detected at concentrations above health-based risk levels and levels protective of ground water in both surface and subsurface soil at the six AOCs in Area 18. Table 1 lists chemicals detected in the soil for which RGs have been established as well as criteria that were used to establish the RGs. Primary VOCs detected in soil include the solvents and solvent related compounds 1,2-dichloroethene (1,2-DCE), toluene, trichloroethene (TCE), and tetrachloroethene (PCE) at maximum concentrations of 934 milligrams per kilogram (mg/kg; one mg/kg equals one part per million [ppm]), 2,000 mg/kg, 1,000 mg/kg, and 9,000 mg/kg respectively. Table 1 lists the maximum concentrations of the chemicals detected in the soil. More detailed information regarding these chemicals in the soil can be found in the Final Area 18 FS. VOCs in soil at Area 18 present a potential risk because they are soluble and may continue to leach into the ground water if left in place. Also, VOCs in surface soil may volatilize into the air, potentially affecting onsite workers. VOCs pose carcinogenic (cancer) and noncarcinogenic (noncancer) risks under potential future land uses (see Table 1).

VOCs at concentrations above RGs (Table 1) are present in soil at AOC-1, AOC-2, and AOC-3. VOCs present at these AOCs are consistent with the use of industrial solvents and hydrocarbon-related chemicals at the Plant. Analytical results from surface and subsurface soil samples indicated that most of the soil contamination in AOC-1 and AOC-3 was present in the upper 12.5 feet of soil. No additional data has been collected past 12.5 feet in AOC-1 or AOC-3. At AOC-2, contaminated soil was also present in the upper 12.5 feet in most the southern half of the AOC. Additional data, collected after the RI, indicates contamination at depths below 12.5 feet in AOC-2. During the FS, it was estimated that approximately 23,000 cubic yards (cy) of soil containing VOCs above either risk-based levels or levels protective of ground water are present in the pits in AOCs 1, 2, and 3. Figures 6 and 7 show the location and concentration of VOCs in the soil at various depth intervals.

Metals in the soil are not a threat to human health under current land uses, but may be a health threat under future site use scenarios. Surface soil samples from Area 18 contained concentrations of copper, mercury, and zinc above acceptable risk-based levels (see Table 1 and the FS). The migration pathway that resulted in unacceptable human risk (noncancer) from exposure to copper, mercury, and zinc was ingestion of beef from cattle that ingested metals during grazing at Area 18. Ingestion of beef from cattle was evaluated under future land-use scenarios.

Although specific carcinogenic and noncarcinogenic risk values are not available for lead, a cleanup goal of 1,000 ppm was established for cleanup of lead. Surface soil samples collected at AOC-4 and AOC-5 were found to contain lead at concentrations above 1,000 ppm. The primary migration pathway for lead in soil is via windblown particles. In general, lead concentrations above 1,000 ppm are confined to the upper two feet of the soil profile. During the FS, it was

estimated that there are approximately 4,700 cy of soil containing lead above 1,000 ppm in AOCs 4 and 5, which are located within the larger AOC-6 area.

2.5.2 Ground Water

Three different ground water bearing units were defined under Area 18 OU. Each shows a distinct ability to transmit (i.e., carry) water and are described as follows:

- Unit 1 (HSU1)—This unit extends from the ground surface to a depth of approximately 20 to 40 feet below the ground surface and is made up of silty clay and fine sand. HSU1 has poor ability to transmit water.

- Unit 2 (HSU2)—This unit (approximately 40 to 45 feet thick) exists from 20 to 40 feet below the ground surface to a maximum depth of 80 to 90 ft, and is made up of medium-grained to coarse sand and sandy gravel with layers of silty clay. HSU2 has good ability to transmit water and is the primary aquifer of the area. An aquifer is a water-bearing unit that can transmit sufficient water for domestic or public use. Figure 4 indicates the approximate local ground water flow direction (with arrows) in the aquifer. These flow directions are influenced by the pumping of extraction wells 17-FF and EW-1.

- Unit 3 (HSU3)—This unit exists below a depth of approximately 90 feet bgs and is made up of shale and limestone layers. HSU3 has poor ability to transmit water.

Hydrologic data collected during the RI indicates there is a ground water gradient divide (roughly along the paleochannel) near Area 18 (see Figure 5). Ground water in the western third of Area 18 generally flows to the west, nearly parallel to the Installation boundary. In the eastern third of the area ground water flows to the northeast toward the Installation boundary. Former water supply well 17-FF (now used as a ground-water extraction well), located directly west of Area 18, influences localized ground water flow by drawing ground water from Area 18 toward the well.

Ground water samples collected from the Area 18 OU during the RI contained several VOCs. Chemicals of concern (COCs) detected in ground water above MCLs are identified in Table 2 along with the maximum concentrations at which the chemicals were detected. Some of the solvents may be in the form of dense non-aqueous phase liquids (DNAPLs). Figure 5 shows the general location and size of the VOC plume at Area 18. Analytical data collected over a two-year period indicate that VOC concentrations in ground water samples are increasing and that contaminants may be spreading.

VOCs that leach into the ground water from the solvent pits present a potential health risk to onsite workers under future land-use scenarios. If VOCs leach into the ground water and migrate offsite in the future, there is a potential threat that offsite residents who use the ground water may be affected. Based on the hydraulic gradient and ground water velocities calculated during the RI, it is estimated that ground water beneath Area 18 traveled a distance of 1,000 feet over a two-year period. TCE and its breakdown components typically migrate in ground water at a velocity

less than that of the ground water itself; however, there is the potential that contaminated ground water could move offsite and affect offsite residents that may drink the water (e.g., in the community of Lake City) in the future.

2.6 SITE RISK SUMMARY

2.6.1 Risk Assessment Process

A baseline risk assessment (BLRA) was conducted during the RI to identify receptors of concern, exposure pathways, and contaminants of concern that drive unacceptable risk to humans. A BLRA evaluates risks under current and anticipated future land uses assuming no remedial action is conducted. The following sections provide a summary of the BLRA conducted for Area 18. The RI contains detailed information regarding the BLRA.

A BLRA consists of:

- Data collection and evaluation
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

The assessment of human health risks for this OU considered the following topics:

(1) COCs in soil and ground water samples.

(2) Current and future land-use conditions.

(3) Potential environmental pathways by which populations might be exposed.

(4) Estimated exposure point concentrations of COCs.

(5) Estimated intake levels of the COCs.

(6) Toxicity of the COCs.

(7) Uncertainties in the assessments of exposure, toxicity, and general risks.

2.6.2 Data Collection and Evaluation

At Area 18, soil (surface and subsurface) and ground water samples were collected and analyzed to complete the BLRA for human and ecological receptors. Once the data was analyzed, COCs were identified by media and a determination was made as to which COCs would be retained for

development of remedial action objectives (RAOs). Table 2 lists the COCs that were retained (based on the BLRA) for RAO development and their concentrations detected in each media. Table 3 lists the COCs that are present above MCLs (RGs for ground water) at Area 18. The COCs at Area 18 include VOCs (primarily solvents and solvent-related compounds [TCE, toluene, PCE, and DCE], in surface and subsurface soil, VOCs and their degradation products (TCE, PCE, DCE, and vinyl chloride) in ground water, and metals (primarily lead) in surface soil.

2.6.3 Exposure Assessment

Data collected during the Data Collection and Evaluation phases are used to determine the estimated exposure point concentrations and estimated intake levels of COCs under the identified exposure pathways.

Exposure pathways by which human populations may be exposed to the COCs in the soil and ground water were identified during the Area 18 OU BLRA. Exposure pathways generally consist of the following four elements:

1) A source and mechanism of release.

2) A retention or transport medium.

3) A point of potential human contact with the medium.

4) An exposure route at the contact or exposure point.

Exposure pathways identified at Area 18 in the BLRA include ingestion of contaminated ground water, incidental ingestion of contaminated soil, dermal contact with contaminated ground water, inhalation of VOCs from ground water and soil, inhalation of soil particles containing contaminants, and ingestion of meat (from cattle that ingested metals while grazing at Area 18). Both current and future land-use scenarios under which potential receptors could be exposed via the pathways listed above were evaluated for Area 18.

Current exposure scenarios evaluated during the BLRA included both onsite and offsite receptors. Onsite receptors include workers engaged in mowing (incidental ingestion of soil, inhalation of soil particles, and inhalation of VOCs from soil), construction workers who excavate soil both above and below the water table (all exposure pathways listed above except ingestion of meat), and National Guardsmen onsite for training (incidental ingestion of soil, inhalation of soil particles, and inhalation of VOCs from soil). Offsite receptors include residents in Lake City who ingest contaminated ground water (as a drinking water source), have dermal contact with contaminated ground water, and/or inhale VOCs in ground water.

Future exposure groups include industrial workers that may work onsite in the future (ingestion of contaminated ground water, ingestion of contaminated soil, dermal contact with contaminated soil, inhalation of soil particles containing contaminants, and inhalation of VOCs from soil) and

offsite residents who may be exposed to contaminated ground water in the future if it moves offsite (ingestion and dermal contact with contaminated ground water and inhalation of VOCs from ground water).

Ecological receptors that may be exposed to contaminants (primarily in the soil) were also evaluated during the BLRA. The ecological risk assessment is described in more detail in Section 2.6.6.

Table 4 summarizes the exposure groups (future scenarios) and exposure routes (by media) evaluated for the Area 18 BLRA.

2.6.4 Toxicity Assessment

The dose-response characteristics for both noncarcinogenic and carcinogenic health effects were quantitatively described for specific exposure routes during the BLRA. Toxicity profiles for COCs were also compiled. Quantitative estimates which describe these relationships have been established by the EPA and were used in the Area 18 BLRA. The following paragraphs summarize the toxicity assessment for noncarcinogenic and carcinogenic effects of COCs at Area 18.

Slope factors (SFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

A more detailed description of the toxicity assessment can be found in the BLRA in the Final Area 18 RI.

The RfDs and SFs for COCs for Area 18 are presented in Table 4.

2.6.5 Risk Characterization (Human Health Risks)

The Area 18 OU RI/FS assessed the potential for unacceptable risks to humans and the environment from being exposed to contaminants at the site. Risk characterization is a compilation of the information included in the data collection phase, the exposure assessment, and the toxicity assessment. The focus of this characterization was on the human health effects that could result from direct exposure to the contaminants in soil and ground water through contact with the skin, ingestion (such as eating), or inhalation (breathing) of soil, dust, or organic vapors. The risks were evaluated for current workers at LCAAP, who may have reason to be in the Area 18 OU; for National Guardsmen, who occasionally conduct maneuvers at the Area 18 OU; and for local residents (both current and future) who use the ground water (HSU2) that is beneath both LCAAP and the community of Lake City as their drinking water source.

The risk assessment also evaluated potential unacceptable risks to persons under possible future land-uses of the Area 18 OU. These future uses include industrial uses (manufacturing or warehousing) and leasing parts of the area for cattle grazing (The meat from these cattle would then be consumed by people.).

Potential carcinogenic (cancer) risks are classified by the increased probability of a person getting cancer in his or her lifetime (i.e., excess lifetime cancer risks) from being exposed to known or suspected cancer-causing chemicals at the site. Excess lifetime cancer risks are determined by multiplying the intake level with the slope factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer over a 70-year lifetime as a result of site-related exposure to a carcinogen, under the specific exposure conditions at a site. According to the NCP and EPA's Risk Assessment Guidance for Superfund (EPA/540/1-89/002) the acceptable carcinogenic risk range is between 1×10^{-4} and 1×10^{-6}. This means there is an increased probability of one additional case in 10,000 to one case in 1,000,000 that an individual will develop cancer above the expected normal rate of 250,000 per 1,000,000 (or one in four). Generally, the $1x10^{-6}$ risk level is used as the point of departure (i.e., $1x10^{-6}$ is the level below which the number of increased cancer occurrences from exposure to specific contaminants cannot be differentiated from other causes) in determining whether remedial action should be considered. Depending upon site-specific information, remediation may or may not be warranted if the total site risk lies within the acceptable risk range.

Noncancer health effects were also assessed for chemicals that have effects other than causing cancer in humans. Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Table 4 summarizes the site risks by exposure point, pathway, and COC and indicates the SFs and RfDs and the associated carcinogenic and noncarcinogenic risks respectively. Tables 5 through 8 summarize the noncarcinogenic and carcinogenic risks for the Area 18 OU for each exposure group and media, for current and future land-uses.

Based on the risk assessment, the only unacceptable cancer risk is for current Lake City residents. However, this risk is primarily due to arsenic and beryllium, which were detected well below their respective MCLs. Section 1.6.2 of the Final Area 18 FS provides additional detail regarding these risks and their implication to remedial action at Area 18.

There were several instances where one or more chemicals detected in the soil or ground water contributed to unacceptable risks to potential future exposure groups. The difference in the risk between current and future exposure groups results from more intrusive site use scenarios in the future. For example, future onsite workers are assumed to excavate in areas now precluded from such activity.

Under future land-use scenarios, there is a potential unacceptable noncancer risk to persons who eat beef from cattle that graze in Area 18. The chemicals of concern are mercury, copper, and zinc in surface soil. Preventing cattle from grazing in the AOC where these metals are present at elevated levels will eliminate this potential unacceptable risk.

VOCs in ground water and surface soil pose a potential risk to future commercial/industrial workers at the Area 18 OU. Breathing vapors from soil that contains TCE near the surface would result in both unacceptable cancer and noncancer risks. Breathing vapors from untreated ground water that contains the VOCs vinyl chloride and 1,1-DCE would result in unacceptable cancer risk, and breathing vapors containing the solvent 1,2-DCE would result in an unacceptable noncancer risk. These same VOCs in ground water also pose a potential unacceptable risk to nearby residents under future land-use scenarios if the VOCs were to move in the aquifer to off-site locations.

The selected remedy will eliminate or mitigate (slow) the routes of exposure for the future exposure groups discussed above where the baseline risk assessment showed a potential for unacceptable risks. This will be achieved by the ground water remediation alternative combined with a remedial action to minimize exposure to COCs in the soil and remove contaminant mass.

Risks from being exposed to lead in surface soil were evaluated using EPA's PRG Screen model. Using this model, a cleanup goal of 1,000 ppm was determined to be protective of human health at Area 18.

2.6.6 Ecological Risk Assessment

In addition to an assessment of human risk, EPA also requires that the baseline risk be evaluated for ecological receptors, such as animals, that live in and around the contaminated areas. The ecological risk assessment identified the contaminants and ecological receptors of concern (terrestrial and aquatic) for Area 18 based on the analytical data and the receptor's use of Area

18. Toxicity Reference Values (TRV's), or numerical values quantifying the exposure assessment for a receptor group (e.g., small mammals), were developed in a three-step process: 1) potential receptors were identified and ranked in terms of site use, trophic level, habitat and contact use, and societal importance; 2) the exposure of the receptors to environmental media was assessed; and 3) TRVs were developed for each route of exposure (i.e., ingestion, inhalation, dermal contact).

The risk characterization, or HI, is computed as the ratio between the actual contaminant concentrations, doses, and body burdens to the TRVs. If the ratio of exposure (anticipated or measured) to the TRV (HI) is less than 1.0, no significant risk was presumed to exist for that particular receptor(s) and contaminant(s). If the HI is in the 1 to 10 range, a small potential for environmental risk effects exist. HIs greater than 10 indicate a significant potential that greater exposures could result in risk effects, and HIs above 100 indicate risk effects may be expected.

Receptors at Area 18 are exposed primarily to surface soil and surface water. The baseline ecological risk assessment concluded that there was no significant risk to aquatic receptors from exposure to sediment or surface water. Risks were identified for small mammals (short-haired shrew and eastern mole) and are associated with metals (some of which were not reported above background levels) through dermal contact and ingestion of plants that take up the metals from the soil. Risks were also identified for raptors (owls and hawks) and are associated with consumption of mice. There are no other apparent risks to other ecological receptors such as medium-sized mammals and birds. There are no risks to threatened or endangered species.

The risks to small mammals (typically the short-haired shrew and eastern mole) were associated with arsenic, copper, chromium, zinc, lead, mercury, and barium, primarily through dermal exposure to soil and ingestion of vegetation (plants can take up significant quantities of copper and zinc since these metals are essential nutrients). HIs ranged from 14.3 (lead) to 483 (copper). However, arsenic, barium, and chromium were not reported to be above background concentrations in many samples, whereas other metals were detected at significant concentrations numerous times. Of this second group of metals, HIs were as follows: copper (HI = 483); zinc (HI = 32); lead (HI = 14.3); mercury (HI = 17.6).

The potential risk to raptors (owls and hawks) from lead (HI = 31) and mercury (HI = 5.96) results from the consumption of mice. Other receptors (raccoon, coyotes, other medium-sized mammals, herons) are not at apparent risk.

In summary, the baseline ecological risk assessment indicated that in Area 18, certain environmental receptors (specifically small mammals, raptors, chicken, and pheasant) are potentially at risk from soil ingestion and/or ingestion of biota containing high concentrations of metals (copper, mercury, zinc).

A detailed discussion of the ecological risk modeling, determination of COCs, ROCs, and predicted HIs for metal toxicity is presented in Section 6.2 of the RI Report. Mean background concentrations were developed for the soil of Area 18 and used in the risk assessment to determine the background HIs at Area 18 for terrestrial receptors.

The majority of COCs that drive ecological risk (e.g., lead, copper, zinc, arsenic, and barium) are co-located with COCs that drive unacceptable human health risk. The baseline ecological risk assessment results were compared with the calculated residual risks remaining to ecological receptors after a remedial action is taken to reduce risks to humans from exposure to chemicals in surface soil. The "residual" risk remaining to ecological receptors will be significantly lower after an action is taken to reduce risks to humans, since many of the same chemicals that affect both humans and animals will be addressed at the same time. It was concluded that there would be no adverse effects to the significant ecological receptors from the residual contamination remaining following a human health-based cleanup.

2.6.7 Risk Assessment Conclusions

A summary of the conditions at the Area 18 OU that could pose human and ecological risk include the following:

1) Risks to nearby residents if VOCs in the ground water move offsite in the future.

2) Risks to future onsite workers from lead in the surface soil.

3) Risks to persons who eat beef from cattle that may graze (in the future) at Area 18.

4) Potential risks from metals in surface soil to small mammals and birds that live on the land.

Actual or threatened releases of hazardous substances from this site, 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.

2.6.8 Remediation Goals

Remediation Goals (RGs) for LCAAP have been established based on risk considerations (see Table 1). These include criteria associated with ingestion of and dermal contact with contaminated soils by the reasonably maximum exposed individual, as well as criteria to evaluate possible leaching of contaminants from soils to ground water at unacceptable levels. For LCAAP, RGs were established at a target carcinogenic risk of 10^{-6}, consistent with the NCP. The NCP states that RGs should be established for individual constituents within the risk range of 10^{-4} to 10^{-6}, with a preference for the most protective values. Commercial/industrial land use is the current and reasonably anticipated future land use at the site upon which the RGs have been based. RGs for additional constituents which may be detected at levels of concern subsequent to the RI, such as during pre-design sampling activities, will be determined using the method which was used to determine the RGs for constituents in Table 1. This methodology is discussed in the Area 18 FS.

In addition to risk-based soil RGs for protection of human health, the impact to ground water from residual soil contamination was evaluated. The Summers model was utilized to estimate

the level at which contaminant concentrations in soils will produce ground water contamination at concentrations above acceptable levels. The Summers model assumes that a percentage of rainfall at the site will infiltrate the surface and desorb contaminants from soils, based on equilibrium soil:water partitioning. It is further assumed that this contaminated infiltration will mix completely with the ground water below the site, resulting in an equilibrium ground water concentration with all contaminants in the final mixture from the infiltration.

The Summers model was used to determine acceptable levels for VOCs in soil. The model was not used for metals, as metals are relatively immobile in the clay soils found at the LCAAP. Further, VOCs are the most prevalent and mobile contaminants found at the site. The site-specific "leaching" RGs for these major contributing contaminants are presented in Table 1. These RGs represent contaminant levels in soils that are considered protective of human health and protective of ground water.

2.7 DESCRIPTION OF ALTERNATIVES

The area of attainment defines the area over which RGs will be achieved, and is based on the RAOs. The area of attainment for soils at Area 18 OU corresponds to the area encompassing the six AOCs illustrated on Figure 4. The area of attainment for ground water at Area 18 OU corresponds to the ground water plume shown on Figure 5.

The RAOs for the Area 18 OU are:

- Prevent human contact with soil containing lead concentrations greater than 1,000 ppm.
- Prohibit agricultural (e.g., grazing) and other non-industrial uses at Area 18.
- Prevent future industrial workers from inhaling VOCs from surface soil.
- Reduce ecological receptor risk from exposure to metals in surface soil.
- Prevent ingestion and dermal contact (future workers) with onsite ground water containing VOCs above regulatory standards.
- Prevent ground water contaminated above regulatory standards from migrating off the Installation.
- Minimize contaminant migration from soil to ground water.

A brief description of the major components of each remedial action alternative developed in the Area 18 FS and Proposed Plan is presented below. Alternative SA-4 (Onsite Incineration/Replacement into Excavation) was screened out in the FS prior to a detailed analysis because of excessive cost and is not presented here. The following alternatives were evaluated in detail in the FS and are numbered to correspond with the text in the FS Report. The selected alternative includes a component to address contaminated soil and contaminated ground water. For clarity, the soil and ground water alternatives are discussed separately (as in the FS and Proposed Plan); however, it is recognized that both the selected soil alternative and the selected ground water alternative must be implemented to meet all the remedial action objectives for the Area 18 OU.

2.7.1 Soil Alternatives

Alternative SA-7 is the selected alternative to address contaminated soil at Area 18 and is described first. Additional alternatives considered for addressing soil at Area 18 are presented following the description of SA-7.

Alternative SA-7: *In-Situ* Multi-Phase Vacuum (MPVE) System and Excavation

Description

Alternative SA-7 addresses surface and subsurface soil at Area 18. Surface soil with lead exceeding the remediation goal (RG) of 1,000 ppm will be addressed one of two ways, either excavating and disposing or covering and managing onsite, depending on whether VOCs are collocated with the lead at levels above RGs. The following major components make up alternative SA-7.

- Surface soils (0-2 feet) containing lead above cleanup levels (1,000 ppm) and not collocated with VOCs exceeding 10 ppm, will be excavated and disposed of in an approved repository. Surface soils containing lead above cleanup levels and collocated with VOCs exceeding 10 ppm and where MPVE will be conducted, will be managed onsite beneath a two-foot soil cover.

- In areas with soil containing VOCs at concentrations above 10 ppm, soil will be left in place and a 2-foot compacted earth cover will be constructed over the contaminated area. VOCs will be removed and treated using an MPVE system.

The following sections provide detailed description of the various components.

Treatment/Containment Components

Lead contamination in the surface soil was delineated during the Area 18 RI. The amount of lead-contaminated soil to be removed and/or covered was determined based on the potential risk to future land users and the lead RG of 1,000 ppm. The areas of VOC contamination in the soil to be treated were determined based on the RG of 10 ppm. The RG for VOCs in the soils was established to address risk to future workers and also to be protective of ground water (i.e., VOCs in the soil at concentrations below 10 ppm will not leach into the ground water at levels above cleanup criteria). Treatment and/or containment components are as follows:

- A pre-construction study to determine the extent of surface soil lead contamination and the areas of collocated lead associated with VOCs exceeding RGs will be performed.

- Surface soil contaminated with lead exceeding the RG of 1,000 ppm, in areas where the VOC concentrations in soil are below the RG of 10 ppm, will be

excavated to a maximum depth of 24 inches and disposed of appropriately. Excavated soil will be tested for Toxicity Characteristic Leaching Procedure (TCLP) criteria to determine its ultimate disposal. Soil failing TCLP criteria will require transportation and disposal as hazardous waste at an approved hazardous waste facility or stabilization and disposal as special waste. Soil that meets TCLP criteria (and other LDRs) will be disposed of as special waste in an appropriate manner. The excavations will be backfilled using clean backfill from an onsite source. The area containing lead above 1,000 ppm and VOCs below 10 ppm is primarily limited to AOC-4 and potentially a small portion of AOC-5 (Figure 4). The volume of lead-contaminated soil to be excavated is approximately 5,000 cy.

- Surface soil containing lead within the areas of VOC contamination above 10 ppm (primarily AOC-5) will be managed in-place beneath the 2-foot earth cover constructed to enhance the MPVE system, described below. The area where VOCs and lead are both above their respective RGs (most of AOC-5) is approximately 12,500 square feet.

- In the areas at Area 18 where VOC concentrations are above 10 ppm, including the areas collocated with lead described above, a 2-foot compacted earth cover will be installed and VOCs will be remediated using a technology known as MPVE. The soil cover will be compacted to minimum of 90 percent of its maximum dry density as determined by standard Proctor test and will be graded to promote positive drainage off the area. The cover will be vegetated to protect it from erosion.

- Vapor and water extracted by the MPVE system will be treated to meet discharge criteria. The specific methods of treatment will be determined during the RD.

MPVE is a variation of soil vapor extraction (SVE) developed specifically for use in low permeability soils, such as those present in Area 18 OU. The MPVE technology uses a very high vacuum (up to 26 inches of mercury) applied to a series of extraction wells, causing soil vapor and ground water to be drawn into the wells. The goal of this system is to lower the ground water table in order to expose more soil to the air flow induced by the vacuum. Contaminants such as chlorinated solvents and some petroleum hydrocarbons are volatilized into the air flowing through the unsaturated zone, drawn into the wells, brought to the surface and destroyed. The system will be installed to remove contaminant mass from the soil and shallow ground water in the low permeability soils to a depth of approximately 30 feet bgs, in areas with VOC concentrations above RGs. The areas containing VOCs above RGs are primarily limited to the solvent pits located in AOCs 1, 2, and 3 (see Figure 4), a combined area of approximately 55,000 square feet. The goal of the system is to remove VOCs to concentrations below the RG of 10 ppm in these areas.

General Components

- Excavation and disposal will address lead contaminated surface soil. Risk from exposure to lead in the surface soil will be eliminated by removing lead-containing soil and backfilling with clean soil. There will be no residual risk from lead at the surface in this area. Excavated soil will be tested (TCLP) to determine whether or not it is hazardous. If it is hazardous, soil will be disposed of at RCRA Subtitle C facility or it will be stabilized and disposed of as special waste. For cost estimating purposes, it is assumed that 25 percent of the excavated material will fail TCLP testing; however, the amount of hazardous waste, if any, will not be known until testing is complete. Soil containing lead at nonhazardous concentrations (based on TCLP testing) will be disposed of at an approved facility. This component of SA-7 could be readily implemented with locally available labor and materials. Hazardous waste will require adherence to DOT regulations and land disposal restrictions.

- The MPVE system will be installed to address VOC-contaminated subsurface soil and shallow ground water to a depth of approximately 30 feet bgs. A 2-foot earth cover will be placed over the area to be remediated using MPVE to increase efficiency of the system by preventing short circuiting of the soil vapor. The goal of the MPVE system is mass removal of VOCs in the soil to concentrations below RGs. Removal of VOCs from the soil will reduce the risk to future onsite workers. It will also reduce the risk to future offsite residents by reducing the source of VOCs in the ground water that could potentially move offsite in the future if no action is taken. The residual risk from VOCs remaining in the soil will not be known until data can be collected from the operating system over an extended period of time. However, the results of a pilot study conducted in 1996 indicate that significant mass removal can be achieved. During the pilot study, data collected indicate a radius of effectiveness for the vacuum system of 30 to 50 feet from an extraction well can be expected at Area 18. A 30-foot radius of influence for each MPVE well was used to approximate the number of extraction wells that might be needed to treat the area. For cost purposes, the area of treatment was assumed to be 100,000 square feet. A predesign study must be conducted to further refine the extent of contamination. Semiannual technical reviews will be used to develop appropriate criteria for shutting down the system. A more specific approach to the development of shutdown procedures is further described in Section 2.9.

  Along with increasing the efficiency of the MPVE system, the 2-foot earth cover will minimize the amount of rainwater that infiltrates into the pit, reducing the potential for the infiltration to transmit chemicals from the soil to the ground water. The cover will also prevent direct exposure to VOCs in the surface soil and minimize risk from exposure to lead in the surface soil in those areas where lead is collocated with VOCs (primarily AOC-5). Since lead would remain in place under the cover at levels above the RG, a 5-year review will be required to

insure that the cover continues to be protective of human health and the environment.

- Vapors collected from the MPVE system will be treated to meet applicable or relevant and appropriate requirements (ARARs) including the Clean Air Act and State of Missouri Air Quality Standards. A study will be conducted during the RD to determine the specific treatment required to meet discharge criteria.

- A bench study will be conducted to determine the required ground water treatment processes. The ground water extracted from the system will meet pre-treatment discharge requirements established by the Little Blue Valley Sewer District (LBVSD) in Permit No. LB-0200-LC504. The need for additional treatment will be determined during remedial design.

- Institutional controls will be implemented to restrict future uses of Area 18 to industrial uses, preventing the use of the site for cattle grazing and other agricultural activities, and construction of residential housing. Institutional controls will include: (1) issuing a continuing order (by the Installation Commander) to restrict or place limitations on access to Area 18; (2) filing a notice in environmental and real estate records at the Installation, detailing the restrictions of the continuing order; and (3) compliance with the provisions of CERCLA Section 120(h)(3) and other applicable statutory requirements in the event of property transfer. Ground water monitoring will also be required to verify the effectiveness of the containment system; however, this can be implemented as part of the ground water remediation option.

- This alternative can be installed within 12-18 months.

Major ARARs

- Alternative SA-7 meets the action-specific and location-specific ARARs for soil at Area 18 OU including fugitive dust regulations, storm water management regulations, land disposal restrictions (LDRs), and deed notations that there are in-place wastes managed on the property. These, and other major action-specific ARARs are summarized in Appendix D. The Area 18 FS Report includes a complete list of action-specific ARARs. There are no chemical-specific ARARs for contaminants in soil. Treatment and discharge of water and vapors generated as part of this remedy will meet appropriate standards.

Alternative SA-1: No Action

- The No Action Alternative is presented as a baseline to which other remedial measures are compared. The National Contingency Plan (NCP) requires that the No Action Alternative option be examined in detail during the remedial alternatives evaluation phase. Under this alternative, no treatment or containment

of any contaminated soil in the Area 18 OU would be conducted and no institutional controls would be placed on future land use.

Alternative SA-2: Multi-Layer Cover and Vertical Barriers

Description

Alternative SA-2 addresses surface soil contaminated with metals and soil contaminated with VOCs. This alternative consists of consolidating VOC and lead-contaminated soil within a perimeter barrier wall and beneath a reduced permeability multi-layer cover. Soils within each AOC which exceed 10 ppm VOCs and soils which exceed 1,000 ppm lead would be excavated and placed within the barrier wall. Excavated areas outside the barrier wall would be backfilled with clean fill material. Any soils found to be TCLP toxic for lead would be stabilized onsite before placement. The barrier wall would be keyed into a competent layer of bedrock to minimize the flow of ground water beneath the barrier wall. Predesign studies would be conducted to determine the most effective material to use for the barrier wall. Ground water would be extracted to create and maintain an inward hydraulic gradient, minimizing the release of contaminated ground water from within the barrier wall. There is approximately 2,500 cy of soil contaminated with VOCs in AOC-1 and 4,700 cy of surface soil contaminated with lead in AOC-4 that would be excavated and placed in AOCs-2, 3, and 5 (which is collocated with AOC-2). Institutional controls would be used to restrict future site use. The following major components make up alternative SA-2:

- Excavating soil from AOC-1 and placement in AOCs-2, 3, and 5.
- Constructing a reduced permeability multi-layer cover over AOCs-2, 3, and 5.
- Constructing a barrier wall around the combined perimeters of AOCs-2, 3, and 5.
- Installing ground water extraction wells in the interior of the containment wall.

The following sections provide detailed descriptions of the various components.

Treatment and/or Containment Components

Lead and VOC contamination in surface and subsurface soil was delineated during the Area 18 RI. The amount of lead-contaminated soil to be removed/covered was determined based on the potential risk to future land users and the lead RG of 1,000 ppm. The areas of VOC contamination in the soil to be addressed were determined based on the RG of 10 ppm. The RG for VOCs in the soils was established to address risk to future workers and also to be protective of ground water (i.e., VOCs in the soil at concentrations below 10 ppm will not leach into the ground water at levels above cleanup criteria.). Treatment and/or containment components are as follows:

- Approximately 2,500 cy of soil contaminated with VOCs above RGs in AOC-1 and 4,700 cy of soil containing lead above RGs from AOC-4 would be excavated and consolidated under the areas proposed to be covered in AOC-2 and AOC-3. Excavation and consolidation of material would occur entirely within the Area 18 OU.

- Post excavation sampling would be conducted to verify that RGs were achieved in AOC-1 and AOC-4.

- Clean backfill would be placed and compacted in the excavated areas of AOC-1 and AOC-4.

- A multi-layer cover consisting of a 24-inch thick compacted clay layer, a geomembrane layer, and a 24-inch thick vegetative layer would be placed over the area of consolidated. The areal extent of the cover required would be approximately 1.9 acres. The cover would reduce the infiltration of rain water and the subsequent leaching of contaminated material from soil. The cover would help to prevent human and ecological receptor exposures to the lead-contaminated soil. Prior to placement of soil beneath the multi-layer cover, the soil containing lead would be tested using the TCLP criteria for lead. To satisfy RCRA LDR criteria, soil failing TCLP lead testing would be stabilized onsite, so it will not leach lead into the ground water, prior to disposal beneath the multi-layer cover. It is not anticipated that there would be significant quantities of soil failing the TCLP test.

- A containment wall (slurry or HDPE depending on predesign studies) would be constructed around the combined perimeter of AOCs 2, 3, and 5 (the approximate area of the soil consolidation) to act as a vertical barrier, restricting the movement of contaminated ground water from Area 18. For cost purposes, it was assumed a slurry wall would be constructed. The slurry wall would be keyed into a competent layer to prevent ground water from flowing under the wall. At Area 18, geologic conditions would require installing the slurry wall to a depth of approximately 90 feet bgs.

- Two ground water extraction wells would be installed within the perimeter of the barrier wall. The wells would extract ground water at a low rate (approximately 5 gallons per minute [gpm]) to create and maintain a slight inward ground water flow within the isolated area. Extracted ground water would be managed as part of the selected ground water alternative.

General Components

- Excavation of contaminated soil from AOCs-1, and 4 would eliminate the risk from VOCs and lead in the soil in these respective areas. Excavation from AOCs-

1 and 4 and placement in AOCs 2, 3, and 5 would be conducted entirely within the Area 18 OU.

- Construction of a barrier wall and multi-layer cover would reduce risk by containing contaminated soil and ground water in the source area.

- A predesign investigation would be performed to:

  - Refine and delineate the vertical and horizontal extent of lead and VOC contamination in the surface and subsurface soil. The delineation effort would extend to a depth of 2 feet below grade in the lead areas and 20 feet below grade in the VOC areas.
  - Determine the compatibility of the vertical barrier material for use in design of the barrier wall.
  - Determine the required ground water extraction rate to maintain an inward gradient within the slurry wall.

- Institutional controls similar to those described under Alternative SA-7 would be implemented to restrict future uses of Area 18.

- Excavation and consolidation of material beneath a multi-layer cover do not impose any unusual or extraordinary conditions that would preclude implementation of this alternative. Material excavated below the water table may require drying prior to placement beneath the cover. Installation of slurry walls keyed into a competent layer requires deep trenching methods and may require special measures to ensure bank stability. The effectiveness of slurry walls in preventing migration of VOCs in ground water requires further evaluation which would be conducted as predesign or pilot studies. Dewatering and treatment of the ground water contained within the slurry wall would also be required. This alternative could be implemented and the remedial action objectives for soil met in 6-9 months. However, because of the quantity of VOCs present in soil (estimated in the FS at 25,000 lbs of VOCs), it is estimated that VOCs would continue to leach into the ground water at significant concentrations for about 200 years under optimal conditions. Placement of the multi-layer cap would reduce or eliminate infiltration and likely extend the time for chemicals to leach out of the soil. This alternative would require that the ground water extraction wells installed within the slurry wall containment be operated indefinitely, or until subsequent reviews indicate that there is no continued benefit to operating the wells (i.e., no continued leaching of chemicals into ground water). Because wastes would be managed in-place, a 5-year review of this alternative would be required to ensure that the alternative continues to be protective of human health and the environment.

- Under this alternative, residual risks to onsite receptors from exposure to contaminated soil would be minimal as long as the cover remained in tact.

Continued operation of the ground water extraction wells within the barrier wall would be required to prevent migration of ground water above MCLs.

Major ARARs

- Alternative SA-2 meets the action-specific and location-specific ARARs for soil at the Area 18 OU including fugitive dust regulations, storm water management regulations, land disposal restrictions (LDRs), and deed notations that there are in-place wastes managed on the property. These, and other major action-specific ARARs are summarized in Appendix D. The Area 18 FS Report includes a complete list of action-specific ARARs. There are no chemical-specific ARARs for contaminants in soil.

Alternative SA-3: Onsite Low Temperature Thermal Desorption

Description

Alternative SA-3 addresses surface soil contaminated with metals and soil contaminated with VOCs. This alternative includes excavating soil contaminated with lead in excess of 1,000 ppm and VOCs in excess of 10 ppm, including VOC-contaminated soil below the water table, from each of the AOCs. When necessary, the excavations would be dewatered so that excavation can continue below the water table. Excavated soil containing VOCs above RGs would be treated onsite using a process called Low Temperature Thermal Desorption (LTTD). Surface soil containing lead above RGs would be tested and stabilized onsite, if necessary. Excavated areas below the water table would be backfilled with clean fill material. Once the excavations are backfilled to an elevation above the water table, treated soil and surface soil containing lead above the RG of 1,000 ppm would be consolidated in the excavations where VOC-contaminated soil was removed. The final 2-foot of fill in all excavated areas would consist of a 2-foot earth cover as described in Alternative SA-7. The following major components make up alternative SA-3:

- Excavating VOC-contaminated soil from AOCs-1, 2, 3, and 5.
- Excavating lead-contaminated surface soil from AOCs-4 and 5.
- Dewatering the excavations where necessary and treating the water if required.
- Treating VOC-contaminated soil using LTTD.
- Backfilling excavations below the water table with clean fill material.
- Consolidating LTTD-treated soil and soil containing lead in the excavations above the water table.

- Constructing a 2-foot thick earth cover over excavations.

The following sections provide detailed descriptions of the various components.

Treatment and Engineering Components

- The volume of soil contaminated with VOCs above RGs is approximately 23,000 cy and is located in AOCs-1, 2, 3, and 5. Soil would be excavated to a depth of 20 feet in AOC-1, the southern half of AOCs-2, and AOC-3 and to a depth of 3 feet in the northern half of AOC-2 and most of AOC-5. Post excavation sampling would be conducted to verify that residual VOCs in the soil are at concentrations below RGs in the excavated areas.

- Ground water entering the excavation during excavation (estimated at 60 gpm) would be collected and treated at the existing Area 18 treatment plant to meet discharge criteria for the existing treatment plant. If necessary, additional pretreatment of the water would be conducted prior to discharging to the Area 18 treatment plant so that discharge requirements are met.

- Excavated soil containing VOCs would be treated onsite using LTTD. LTTD is a process designed to remove organic contaminants from excavated soil and sludge by using air, heat, and/or mechanical agitation. The removed contaminants are then collected and treated. Treated soil would be tested to verify that RGs and TCLP limits are met prior to placing material back into the excavations.

- That portion of the excavation that lies below the depth of the typical water table (approximately 7 feet bgs) would be backfilled with clean material.

- Soil treated using LTTD would be placed back into the excavations at depths above the water table.

- The upper 2 feet of soil in AOCs-4 and 5 (approximately 4,700 cy and 1,200 cy respectively) containing lead concentrations greater than 1,000 ppm and meeting RCRA LDR criteria (as described under Alternative SA-2), would be excavated and consolidated in the areas of AOCs-1, 2, and 3 where VOC-contaminated soil was excavated. Material exceeding LDR criteria for metals would be stabilized onsite prior to placing the final 2-foot cover.

- A 2-foot earth cover would be constructed over the area containing the consolidated waste. The cover would be graded for positive drainage and vegetated to minimize infiltration and erosion.

General Components

- Excavation of soil containing VOCs above RGs, including that below the water table, and treatment of the soil by LTTD would eliminate unacceptable risk from VOCs in the soil. Remaining VOC concentrations would also be protective of the ground water.

- Excavation and consolidation beneath a 2-foot earth cover of surface soil with lead concentrations above RGs would eliminate risk from exposure to surface soil containing lead. Excavation and consolidation of material would be conducted entirely within the Area 18 OU.

- A predesign investigation would be performed to refine and delineate the vertical and horizontal extent of lead and VOC contamination in the surface and subsurface soil, obtain design data, and to classify the waste.

- Institutional controls as those described under Alternative SA-2 would be implemented.

- Implementation of an LTTD system requires the services of specialized vendors, but these vendors are readily available. It would be necessary for the LTTD system to comply with the substantive requirements of the Clean Air Act and State of Missouri Air Quality Standards. Because this would be an onsite CERCLA response action, administrative permits otherwise necessary would not be required. Excavation below the water table would require dewatering and potentially treating the water if chemical concentrations are above discharge criteria. It may also be necessary to shore the sidewalls of the excavation to maintain slope stability. This alternative could be implemented and remedial objectives met within 15 months. Because wastes would be managed in-place, a 5-year review of this alternative would be required to ensure that the alternative continues to be protective of human health and the environment.

Major ARARs

- The major ARARs for Alternative SA-3 are the same as those described in Alternative SA-2. In addition, emissions from the LTTD unit would be treated to comply with Clean Air Act requirement and Missouri Air Quality Standards. These, and other major action-specific ARARs are summarized in Appendix D. Alternative SA-3 would meet RGs for soil.

Alternative SA-4: Onsite Incineration

This Alternative was screened from further consideration in Chapter 3 of the FS, which defines and screens initial alternatives prior to detailed evaluation. It will not be discussed further in this document.

Alternative SA-5: Excavation and Offsite Treatment and Disposal

Description

Alternative SA-5 addresses surface soil contaminated with metals and soil contaminated with VOCs. This alternative is similar to Alternative SA-3 except that excavated soil contaminated with lead in excess of 1,000 ppm and VOCs in excess of 10 ppm would be disposed of at an approved offsite facility. The following major components make up alternative SA-5:

- Excavating soil containing VOCs above 10 ppm from AOCs-1, 2, 3, and 5.
- Excavating surface soil containing lead above 1,000 ppm from AOCs-4 and 5.
- Dewatering the excavations where necessary and treating the water if required.
- Offsite disposal of excavated soil.
- Backfilling excavations with clean fill material.

The following sections provide detailed descriptions of the various components.

Treatment and Engineering Components

- This alternative is similar to SA-3 with the exception that the VOC-contaminated soil (above 10 ppm) from AOC-1, AOC-2, and AOC-3 and lead contaminated soil (above 1,000 ppm) from AOC-4 and AOC-5 would be excavated and disposed at a RCRA-permitted facility instead of being treated onsite.
- Excavated material would be tested to make a determination of applicable RCRA waste codes for purposes of identifying appropriate offsite disposal facilities.
- Approximately 23,000 cy of uncontaminated fill would be used to fill the excavation.

General Components

- There would be no residual unacceptable risk from either lead or VOCs in the soil since soil contaminated above RGs would be excavated and disposed of offsite.
- A predesign investigation would be performed to refine and delineate the vertical and horizontal extent of lead and VOC contamination in the surface and subsurface soil, obtain design data, and classify the waste.

- Institutional controls similar to those described under Alternative SA-2 would be implemented.

- Material removed from the site would require disposal in RCRA Subtitle C (hazardous waste) or Subtitle D (solid waste) facilities. Deep excavation would be required as under Alternative SA-3. This alternative could be implemented and remedial objectives met within 2-4 months.

Major ARARs

- The major ARARs for this alternative are similar to the ones for Alternative SA-3. LDRs and transportation of hazardous wastes are two ARARs to be met under this alternative. These and other major action-specific ARARs are summarized in Appendix D. Alternative SA-5 would meet RGs for soil.

Alternative SA-6: Excavation and *Ex-Situ* Landfarming

Description

Alternative SA-6 addresses surface soil contaminated with metals and soil contaminated with VOCs. This alternative is similar to Alternative SA-3 except for the technology used to treat VOC-contaminated soil. Under Alternative SA-6, soil containing VOCs above RGs would be excavated and treated onsite using landfarming technology. The volume of material to be treated under Alternative SA-6 is the same as that under Alternative SA-3. As in Alternative SA-3, treated soil would be returned to the excavation once RGs have been met. Lead contaminated soil (above 1,000 ppm) in AOC-4 and AOC-5 would be excavated and consolidated in AOCs 1, 2, and 3. The final 2-foot of fill in all excavated areas would consist of a 2-foot earth cover as described in Alternative SA-7. The following major components make up alternative SA-5:

- Excavating soil containing VOCs above 10 ppm from AOCs-1, 2, 3, and 5.

- Excavating surface soil containing lead above 1,000 ppm from AOCs-4 and 5.

- Dewatering the excavations where necessary and treating the water if required.

- Landfarming soil containing VOCs above RGs.

- Backfilling excavations below the water table with clean fill material.

- Place soil treated using landfarming back into the excavations at depths above the water table.

- Consolidate soil containing lead above 1,000 ppm excavated from AOCs-4 and 5 (approximately 4,700 cy and 1,200 cy respectively) in AOCs 1, 2, and 3. Material

exceeding TCLP requirements for lead would be stabilized onsite prior to placing the final 2-foot cover.

- Construct a 2-foot earth cover over the area containing the consolidated waste. Grade the cover for positive drainage and vegetate the cover to minimize infiltration and erosion.

The following sections provide detailed descriptions of the various components.

Treatment Components

- This alternative is similar to SA-3 (i.e., volume of material to be treated is the same) with the exception that the VOC-contaminated soil from AOC-1, AOC-2, and AOC-3 would be treated using landfarming technology instead of LTTD and then would be returned to the excavation. Landfarming consists of applying affected material to a plot of land at controlled rates, mixing it with the surface soil, and allowing the physical, chemical, and biological systems that exist naturally in the soil to reduce chemical concentration through volatilization, desorption, degradation, and immobilization of the chemicals. Measures would be taken to optimize the remediation timeframe for landfarming. These measures would include aeration, pH adjustment, nutrient addition, moisture control, and/or mixing. A significant portion of the VOCs in the soil would volatilize into the air, resulting in media transfer. To reduce exposure risks, it may be necessary to collect and treat volatilized VOCs. Landfarming pilot studies have been conducted on the contaminated soils at the Area 18 OU (*Landfarming Treatability Pilot Study Report Areas 17 and 18 Operable Unit*, Burns & McDonnell, 1997). Results of the studies indicate that landfarming would be effective in treating the source area soils to levels consistent with site RGs. Because of the media transfer, there are two options associated with this alternative:

  Option 1: Landfarming of Contaminated Soil Without Air Controls

  Landfarming would be performed outdoors and would not include constructed air controls. VOC emissions would be monitored and controlled by the rate of application and tilling of the contaminated soil.

  Option 2: Landfarming of Contaminated Soil With Air Controls

  This option would include the collection, treatment, and destruction of vapors generated during landfarming. Landfarming would be performed in a closed structure under this option.

- Treated soil would be placed back into the excavations.

- Lead contaminated soil (above 1,000 ppm) in AOCs-4 and 5 would be excavated and consolidated in AOCs 1, 2, and 3.

- A 2-foot earth cover would be constructed over the area containing the consolidated waste, graded for positive drainage, and vegetated.

General Components

- Excavation of soil containing VOCs above RGs, including that below the water table, and treatment of the soil by landfarming would eliminate unacceptable risk from VOCs in the soil. Remaining VOC concentrations would also be protective of the ground water.

- Excavation and consolidation beneath a 2-foot earth cover of surface soil with lead concentrations above RGs would eliminate risk from exposure to surface soil containing lead. Excavation and consolidation of material would be conducted entirely within the Area 18 OU.

- A predesign investigation would be performed to refine and delineate the vertical and horizontal extent of lead and VOC contamination in the surface and subsurface soil, obtain design data, and classify the waste.

- Institutional controls similar to those described under Alternative SA-2 would be implemented.

- Implementation of this alternative would require construction of a landfarming treatment pad and may require construction of a building if it is determined that air emission requirements are not being met. However, it is anticipated that controlled application of material to the landfarm would prevent air emission regulations from being exceeded. This alternative could be implemented and remedial objectives met within 24 months.

Major ARARs

- ARARs for this alternative are the same as under Alternative SA-3. Major action-specific and location-specific ARARs are summarized in Appendix D. Alternative SA-6 would meet RGs for soil.

Alternative SA-8: Selective Excavation/Treatment or Disposal

Description

Alternative SA-8 is a combination of components of the other alternatives. All the aspects of Alternative SA-8 have been described under previous alternatives. This alternative consists of excavation of the same areas as described in Alternative SA-5. The

only difference relative to the areas of excavation is that soil containing VOCs above RGs in AOCs-1, 2, and 3 would be excavated only to the depth of the water table. VOCs in the soil below the water table would be left in place and addressed by the ground water treatment component of the selected remedies. Four options were considered to treat excavated soil containing VOCs; LTTD, landfarming without air controls, landfarming with air controls, and offsite treatment and disposal. Soil containing lead above RGs would either be excavated and consolidated or disposed of offsite. The major components that make up alternative SA-8 have been previously described in Alternatives SA-2 through SA-7. Only significant differences will be discussed in the following sections.

Treatment and Engineering Components

- Excavation of VOC contaminated soil at AOC-1, AOC-2, and AOC-3 under this alternative is similar to that under Alternative SA-5, except that excavation would be conducted to remove only the VOC-contaminated soil above the water table. Surface soil containing lead above the RG of 1,000 ppm from AOC-4 and AOC-5 would be excavated as described under Alternative SA-5. Alternative SA-8 includes excavation of approximately 10,000 cy of soil contaminated with VOCs (above the water table only, estimated at 7 feet below grade) and excavation of approximately 4,700 cy of soil contaminated with lead.

- Four treatment options under Alternative SA-8 to address the excavated soil include:

  Option 1: LTTD treatment of VOC contaminated soil and consolidation of lead contaminated soil as described in Alternative SA-3.

  Option 2a: Landfarming, without air controls, of VOC contaminated soil and consolidation of lead contaminated soil as described in Alternative SA-6.

  Option 2b: Landfarming, with air controls, of VOC contaminated soil and consolidation of lead contaminated soil as described in Alternative SA-6.

  Option 3: Offsite treatment and disposal as described in Alternative SA-5.

General Components

- Some residual risk from VOCs in the soil below the ground water table would remain. The selected ground water alternative would have to be implemented to address contaminants in the soil below the ground water table and ground water containing chemicals above MCLs.

- A predesign investigation would be performed to refine and delineate the vertical and horizontal extent of lead and VOC contamination in the surface and subsurface soil above the water table, obtain design data, and classify the waste.

- Institutional controls similar to those described under Alternative SA-2 would be implemented.

- Implementation considerations of this alternative are similar to those previously described in Alternatives SA-2 through SA-8, depending on the option selected. Alternative SA-8 would meet the RGs for the soil above the water table. The remaining VOCs below the ground water table would be treated by the selected ground water remediation alternative that would be used in conjunction with this soil remedial alternative.

Major ARARs

- The major ARARs are as described in the previous alternatives. Major action-specific and location specific ARARs are summarized in Appendix D.

2.7.2 Ground Water Alternatives

Alternative GW-4 is the selected alternative to address contaminated ground water at Area 18 and is described first. Additional alternatives considered for addressing ground water at Area 18 are presented following the description of GW-4.

Alternative GW-4: Extraction Wells (One Deep and Four Shallow) Air Stripping/Catalytic Oxidation/Discharge

Description

Alternative GW-4 addresses contaminated ground water at Area 18. Contaminated ground water will be removed using extraction wells and/or extraction trenches. Both new and existing wells will be used. Wells will be installed near the plant boundary to prevent offsite movement of ground water contaminated above MCLs. Wells and/or trenches will also be installed in or near the source area to address contaminated ground water that could continue to move from the source if no action is taken. Extracted ground water will be treated using an existing onsite air stripper equipped with catalytic oxidation offgas treatment. The treatment plant was constructed in accordance with the June 1995 Action Memorandum for a Removal Action and is currently operating. It was designed with excess capacity so that additional waste streams can be added. Pretreatment of ground water will be conducted if necessary to meet LBVSD requirements. The following major components make up Alternative GW-4:

- Continued use of extraction well EW-1 which was installed as part of the 1995 removal action to contain ground water onsite.

- Operation of existing water supply well 17-FF as a ground water extraction well for remediation. Well 17-FF will no longer be used as a water supply well.

- Installation of four shallow extraction wells or extraction trenches in the vicinity of the source area.

- Treatment of extracted ground water using the existing Area 18 air stripper.

- Treatment of offgasses from the air stripper using catalytic oxidation to destroy VOCs.

- Discharge of treated ground water to the LBVSD. Ground water will be treated to meet LBVSD discharge requirements.

Treatment and/or Containment Components

Ground water contamination was delineated during the Area 18 RI. Ground water modeling was conducted as part of the RI to predict how fast and in what directions contaminants in the ground water at Area 18 could move. Results of the ground water modeling were used to help determine the proposed locations of extraction wells and/or trenches. Ground water from these wells and/or trenches will be treated to meet the LBVSD discharge requirements of Permit No. LB-0200-LC504. Appendix C lists the discharge requirements described in the permit. Treatment components are as follows:

- Continued operation of EW-1 which was installed as part of the removal action. The location of EW-1 is shown on Figure 5. It is estimated that EW-1 will initially be pumped at approximately 380 gpm; however, the rate will be adjusted so that containment of contaminated ground water within LCAAP boundaries can be achieved at the lowest extraction rate possible. Operation of this well, along with continued operation of well 17-FF (described below) will prevent the offsite movement of contaminated ground water.

- Continued operation of well 17-FF for ground water remediation. The well will no longer be used as a water supply well. It is estimated that 17-FF will initially be pumped at approximately 90 gpm; however, the rate may be adjusted so that containment of contaminated ground water within LCAAP boundaries can be achieved at the lowest extraction rate possible.

- Installation of ground water extraction wells or ground water extraction trenches in the shallow aquifer in the vicinity of the source area to recover additional VOC mass in soil left in place below the water table. The installation of shallow wells/trenches will allow removal of more contaminant mass in the shallow aquifer in a shorter time frame. For cost purposes, it is assumed that four wells will be installed in the source area.

- Extracted ground water will be treated using an onsite air stripping unit equipped with catalytic oxidation off-gas treatment to destroy VOCs removed from the ground water. The treatment plant was constructed in accordance with the June 1995 Action Memorandum and associated design specifications. Extraction and treatment of ground water will be continued until RGs are achieved.

- Treated ground water will be discharged to the LBVSD. Treated ground water will meet LBVSD discharge requirements.

General Components

- Extraction wells EW-1 and 17-FF will address current and potential future risk associated with VOCs in the ground water. These wells will operate in combination to prevent contaminated ground water from moving offsite. Prevention of offsite migration will eliminate future risk to offsite receptors who use the ground water as their source of drinking water. The operating rates of the wells will be adjusted to the lowest extraction rate that will contain contaminated ground water onsite. This will minimize the amount of water that will be treated at any one time and will reduce the potential for smearing contaminants between the NECOU and Area 18. The wells will be operated until RGs are achieved. The wells and/or trenches installed in the source area will remove additional VOC mass at the source, reducing the amount of contamination leaving the source area and allowing a faster cleanup of the ground water. The location, depths, and pumping rates of the wells or trenches in the source area will be determined during remedial design. For cost purposes, it is estimated that four additional wells will be installed and will produce an estimated 50 gpm of ground water to be treated. The number of wells and pumping rates will be refined during remedial design.

- Air stripping will remove VOCs from the ground water. The existing Area 18 treatment plant will be used to treat the water removed by the wells and/or trenches. Catalytic oxidation will destroy VOCs in the offgas.

- Institutional controls will be implemented to restrict future uses of the site to industrial uses and to prevent the use of untreated ground water extracted onsite. Institutional controls will include: (1) issuing a continuing order (by the Installation Commander) to restrict or place limitations on installation of any new ground water wells on LCAAP property; (2) filing a notice in environmental and real estate records at the Installation, detailing the restrictions of the continuing order and ground water well restrictions; and (3) compliance with the provisions of CERCLA Section 120(h)(3) or other applicable statutory requirements in the event of property transfer.

- Long-term ground water monitoring for VOCs, to detect potential movement of contaminants in the ground water and to determine the effectiveness of the

alternative will be implemented. Monitoring will be conducted at a frequency sufficient to verify that contaminants above MCLs are not moving beyond the Installation boundary. As part of the long term ground water monitoring, 12 new monitoring wells have been installed within and at the edge of the VOC plume (4 each in HSU1, HSU2-intermediate, and HSU2-deep). Installation of additional monitoring wells and monitoring of existing wells, which may include off-Post residential wells, for VOCs may be required to monitor system performance. This will be specified as a component of the long-term ground water monitoring plan developed during remedial design.

- Monitoring of the treatment system effluent will continue to be conducted to verify effectiveness of treatment. Weekly monitoring of the effluent is currently conducted as part of the LBVSD pretreatment requirements.

- The ground water remediation system will be operated until RGs have been met for four consecutive quarters. Once this occurs, the ground water extraction system will be shut down and the ground water will be monitored for four additional quarters to verify the effectiveness of the treatment.

- This alternative can be installed and in operation within 12-18 months; however, based on ground water modeling, it may take in excess of 50 years to achieve MCLs in onsite ground water. Ground water containing contaminants above MCLs will be contained onsite.

Major ARARs

- This alternative will meet chemical-specific ARARs for ground water, specifically MCLs established under the Safe Drinking Water Act and State of Missouri ground water quality standards will be met at the Installation boundary. Ground water modeling conducted during the FS indicated that ground water treatment may require in excess of 50 years to achieve MCLs. Ground water containing contaminants above MCLs will be contained onsite. Air emissions from the stripper and catalytic oxidation unit will meet Clean Air Act and State of Missouri Air Quality Standards. Major action-specific and location specific ARARs are summarized in Appendix D. This alternative will meet RGs for ground water at Area 18.

Alternative GW-1: No Action

- The No Action Alternative is presented as a baseline to which other remedial measures are compared. The National Contingency Plan (NCP) requires that the No Action Alternative option be examined in detail during the remedial alternatives evaluation phase. Under this alternative, no treatment or containment of contaminated ground water would be conducted and no institutional controls would be placed on future ground water use.

Alternative GW-2: Limited Ground Water Extraction/Ground Water Monitoring/Point-of-Use Treatment

Description

Alternative GW-2 addresses contaminated ground water at Area 18. Contaminated ground water would be removed from the ground water using existing water supply well 17-FF. As with Alternative GW-4, removed ground water would be treated using the existing Area 18 air stripper equipped with catalytic oxidation offgas treatment. Point-of-use treatment would be used for offsite residents if, in the future, it is determined that ground water contaminants have moved offsite and are contaminating offsite resident's drinking water. At the present time, there is no indication that ground water contamination from Area 18 has moved beyond the Installation boundary. The following major components make Alternative GW-2:

- Continued use of production well 17 FF to contain ground water onsite.
- Treatment of extracted ground water using the existing Area 18 air stripper.
- Treatment of offgasses from the air stripper using catalytic oxidation to destroy VOCs.
- Implementing a point-of-use treatment system, as necessary, if future offsite resident's drinking water wells become contaminated with ground water contaminants from Area 18.
- Discharge of treated ground water to the LBVSD. Ground water would be treated to meet LBVSD discharge requirements.

Treatment and Engineering Components

- Continue operation of well 17-FF for use in ground water remediation; however, the well would no longer be used as a water supply well. It is estimated that 17-FF would initially be pumped at approximately 90 gpm; however, the rate would be adjusted to optimize the ratio of contaminant extraction to ground water extraction. Continued operation of well 17-FF would reduce the offsite movement of contaminated ground water; however, ground water modeling conducted during the FS indicates that operation of well 17-FF alone likely would not totally prevent offsite movement of contaminated ground water.
- The existing Area 18 treatment plant would be used to treat extracted ground water as described under Alternative GW-4.

General Components

- Extraction well 17-FF would address current and potential future risk associated with VOCs in the ground water; however, operation of well 17-FF alone would likely not prevent the offsite migration of contaminated ground water. Therefore, there would be some residual risk from remaining VOCs in the ground water. The operating rate of the well would be adjusted to minimize the amount of water treated at any one time and reduce the potential for smearing contaminants between the NECOU and Area 18. The well would be operated until RGs are achieved or until no further benefit can be achieved by operation of this well alone, at which time a review of the remedy would be required.

- The same institutional controls would be implemented as under Alternative GW-4.

- Monitoring would be conducted at a frequency sufficient to verify that contaminants above RGs are not migrating beyond the Installation boundary. Monitoring of intermediate and deep wells along the boundary and off-Post for VOCs, explosives, and metals to detect potential offsite migration of contaminants in ground water. Specific locations for monitoring ground water would be determined during the remedial design.

- If VOC contamination in ground water is detected in off-Post wells, a point-of-use treatment program would be implemented for offsite consumers who use ground water extracted from those areas potentially impacted by contaminants from Area 18. Off-Post residential wells requiring point-of-use treatment (e.g., a single point-of-use air stripping unit) would be outfitted as required.

- Implement a point-of-use treatment system monitoring plan to verify the effectiveness of the systems and ensure effectiveness of the point-of-use treatment system(s). Sampling for VOCs would be conducted on a quarterly basis or other interval sufficient to verify that the point-of-use treatment systems remain effective.

- This alternative could be implemented using standard methods and equipment that are readily available. Existing ground water wells could be used to detect potential contaminant migration. Offsite point-of-use treatment systems are readily available. Successful implementation would be evaluated and monitored with an effective operations and maintenance (O&M) program of the system to ensure consumed ground water is below MCLs.

Major ARARs

- This alternative would not meet chemical-specific ARARs for ground water, specifically MCLs established under the Safe Drinking Water Act and State of

Missouri ground water quality standards. Ground water modeling conducted during the FS indicated that chemicals in the ground water will remain above MCLs and continue to migrate both on-Post and off-Post under the existing pumping scenario. Major action-specific and location specific ARARs are summarized in Appendix D.

Alternative GW-3: Extraction Wells/Air Stripping/Catalytic Oxidation/Discharge

Description

Alternative GW-3 is the same as that for GW-4 (above), except that the shallow ground water wells in the source area have been deleted. The containment wells (17-FF and EW-1) would be used to intercept contaminants as they move from the source areas. The components of this alternative have been implemented in accordance with the June 1995 Action Memorandum.

Treatment and Engineering Components

- Continued operation of EW-1 as described in Alternative GW-4.
- Continue operation of well 17-FF for use in ground water remediation as described in Alternative GW-4.
- Treatment of extracted ground water as described in Alternative GW-4.
- Discharge of treated ground water as described in Alternative GW-4.

General Components

- Risk from exposure to VOCs in the ground water would be eliminated by removing and treating contaminated ground water before it moves offsite. The remediation time for this alternative would be longer than for Alternative GW-4 since no source area wells/trenches would be used.
- Institutional controls as described in Alternative GW-4 would be implemented.
- Long-term ground water monitoring for VOCs, to detect potential movement of contaminants in the ground water and to determine the effectiveness of the alternative would be implemented. The same as described in Alternative GW-4.
- Monitoring and shutdown of the treatment system as described in Alternative GW-4.

Major ARARs

- This alternative would meet chemical-specific ARARs for ground water, specifically MCLs established under the Safe Drinking Water Act and State of Missouri ground water quality standards would be met at the Installation boundary. Ground water modeling conducted during the FS indicated that ground water treatment may require in excess of 50 years to achieve MCLs; ground water containing contaminants above MCLs would be contained onsite. Air emissions from the stripper and catalytic oxidation unit would meet Clean Air Act and State of Missouri Air Quality Standards. Major action-specific and location specific ARARs are summarized in Appendix D. This alternative would meet RGs for ground water at Area 18.

2.8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The RAOs for the Area 18 OU as established in the Area 18 FS are:

- Prevent human contact with soil with lead concentration greater than 1,000 ppm.
- Prohibit agricultural (e.g., cattle grazing) and other non-industrial uses at Area 18.
- Prevent future industrial workers from inhaling VOCs from surface soil.
- Reduce ecological receptor risk from exposure to metals in surface soil.
- Prevent ingestion and dermal contact (future workers) with onsite ground water above regulatory standards.
- Prevent ground water contaminated above regulatory standards from migrating off the Installation.
- Minimize contaminant migration from soil to ground water.

Pursuant to Section 300.430(e)(9)(iii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the remedial action to be implemented should be selected based upon consideration of nine evaluation criteria. These criteria are as follows:

Threshold Criteria

1. Overall protection of human health and environment.
2. Compliance with applicable or relevant and appropriate requirements (ARARs).

Primary Balancing Criteria

3. Long-term effectiveness and permanence.
4. Reduction of toxicity, mobility, or volume of contamination.
5. Short-term effectiveness.
6. Implementability.
7. Cost.

Modifying Criteria

8. State acceptance.
9. Community acceptance.

The following sections provide a brief review and comparison of the remedial alternatives according to EPA's evaluation criteria.

2.8.1 Overall Protection of Human Health and the Environment

This criterion considers whether a remedy provides adequate protection and describes how risks are mitigated through treatment, engineering, or institutional controls.

Soil

Alternative SA-1 does nothing to reduce risk levels associated with exposure to VOCs and metals in soil at Area 18. Alternative SA-2 would contain VOC and lead-contaminated soil, eliminating exposure to human and ecological receptors; however, since the waste is managed in-place and waste is present below the water table, SA-2 does not provide the level of protection that other alternatives do. Alternatives SA-3, 5, and 6 provide a similar level of protection of human health and the environment through removal and treatment of contaminated soil, with each alternative utilizing excavation and ex-situ treatment of contaminants. SA-5 specifies offsite management of wastes. The selected Alternative, SA-7, utilizes an *in situ* MPVE system to extract contaminants from soil with an onsite treatment system to treat extracted vapors and ground water. Pilot study tests have shown that Alternative SA-7 may be able to extract contaminants in soils from greater depths below the surface than can practically be attained with the other alternatives involving excavation and ex-situ treatment. Alternatives SA-2 through SA-8 all significantly reduce ecological risks from exposure to contaminants in surface soil. All alternatives except SA-1 use institutional controls to prevent cattle grazing (and other agricultural uses) and to restrict land use to uses compatible with the alternatives.

In conjunction with selected ground water Alternative, GW-4, Alternative SA-7 provides the potential for the highest degree of source removal among the soil alternatives considered and will achieve RGs.

Ground Water

Alternative GW-1 is the No Action Alternative and does not provide protection of human health and the environment. Alternative GW-2 would reduce the quantity of contaminated ground water in the dissolved phased by continued operation of existing well 17-FF. Alternative GW-2 does not provide for containment of the Area 18 ground water plume and would allow contaminated ground water at levels exceeding MCLs to migrate beyond the LCAAP boundary. Alternative GW-2 does not provide for remediation of the plume onsite to levels below MCLs. Alternatives GW-3 and GW-4 both provide protection by extracting and treating ground water so that MCLs can be met at the Installation boundary. Alternative GW-3 provides for containment

of the existing Area 18 ground water contaminant plume within its existing limits, but does not attempt to address shallow ground water in proximity to sources. In addition to containment offered by Alternative GW-3, Alternative GW-4 provides added protectiveness by incorporating extraction wells in proximity to source areas to actively treat highly contaminated material in the source area below the water table.

2.8.2 Compliance with ARARs

Alternatives are evaluated under this criterion to assess compliance with ARARs. Applicable requirements include cleanup standards, standards of control and other substantive environmental protection requirements, and criteria or limitations promulgated under federal or state laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site.

Relevant and appropriate requirements address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the environmental and technical factors at a particular site. The determination of "relevant and appropriate" emphasizes the similarity and appropriateness of the requirement to a site. ARARs are grouped into these three categories:

- **Chemical-Specific** ARARs are health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in establishment of the amount or concentration that may be found in, or safely discharged to, the environment.

- **Location-Specific** ARARs restrict the concentration of hazardous substances or the conduct of activities solely because they are in specific locations such as flood plains, wetlands, historic places, and sensitive ecosystems or habitats.

- **Action-Specific** ARARs are usually technology or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

A summary evaluation of Federal and State ARARs pertinent to this remedial action is provided in Appendix D at the end of Section 2.0 and a narrative discussion of compliance with ARARs is provided below for the alternatives considered.

Soil

In the absence of chemical-specific ARARs, RGs have been established for soil at Area 18. Alternative SA-1 does not meet RGs. Alternative SA-2 utilizes containment rather than treatment to abate risks associated with soil contamination. Thus, waste would remain in-place and soil RGs would not be achieved. Alternative SA-2 requires ground water control as part of the alternative to meet ground water MCLs since waste is managed in place and is present below the water table. Alternatives SA-3, 5, and 6 would achieve soil RGs to a depth of 15 feet bgs. The alternatives use different treatment methods to achieve the RGs. Alternative SA-8 is similar

to Alternatives SA-3, 5, and 6, except that RGs are achieved only for soils above the water table, which is approximately 7 feet bgs. Alternative SA-7 has the potential to achieve soil RGs to a depth of nearly 30 feet bgs, and thus has the potential to remove a large amount of contaminant mass from the soil. Technical review of the selected alternative will be conducted as specified in Section 2.9 to determine the systems compliance with RGs.

Action and location-specific ARARs are similar for most of the alternatives. Appendix D lists the action and location-specific ARARs for the various alternatives. Major action-specific ARARs would include storm water management and Clean Air Act Amendments. Major location-specific ARARs would include consideration of wetlands and floodplain management requirements.

Ground Water

Alternatives GW-1 and GW-2 would not meet MCLs or State Ground Water Quality Standards at the Installation boundary and would not prevent ground water contaminated with chemicals above MCLs from moving beyond the Installation boundary. Alternatives GW-3, and GW-4 meet MCLs at the Installation boundary by preventing the movement of contaminated ground water offsite. Under Alternatives GW-2, GW-3, and GW-4, extracted ground water would be pre-treated to meet discharge requirements of the LBVSD. GW-3 and GW-4 would provide containment of the existing plume and, in conjunction with the selected soil alternative, SA-7, will ultimately remediate the aquifer to MCLs within the Area 18 OU. If, due to site conditions or technical limitations, it is not practical to remediate onsite ground water to levels below MCLs a Technical Impracticability waiver could be evaluated.

2.8.3 Long-term Effectiveness and Permanence

This criterion considers the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response action objectives have been met.

Soil

All the alternatives, other than the No Action alternative, provide long-term effectiveness in reducing potential risks associated with the soil. SA-2 is a less permanent solution than the other alternatives because wastes are managed in-place, thus SA-2 would rely on effective operations and maintenance of the containment system. Alternatives SA-3, SA-8 (Options 1 and 2b), and selected Alternative SA-7 use destructive technologies to treat VOCs removed from the soil. SA-7 incorporates an innovative technology and its ability to extract VOCs may vary according to site geology. However, pilot studies at LCAAP have indicated effective mass removal for this technology. Contaminated soil would be disposed of offsite (in a RCRA permitted facility) under Alternatives SA-5 and SA-8 (Option 4) and may or may not be treated prior to disposal depending on the classification of the soil (i.e., hazardous or nonhazardous) and the facility requirements. Alternatives SA-6 and SA-8 (Options 2a) use media transfer to remediate contaminated soil. Under Alternative SA-8, contaminated soil would be left below the water table to be addressed by the selected ground water alternative.

Ground Water

Alternative GW-1 would not provide long-term effectiveness in reducing the potential for movement of VOCs or meeting MCLs. GW-2 reduces the amount of contamination in ground water through extraction and treatment; however, the reduction is not sufficient to meet MCLs within the plume, or to contain the plume within LCAAP boundaries. Both Alternatives GW-3 and GW-4 are effective in the long-term and provide permanent remedies for ground water at Area 18. Each alternative would require intensive operations and maintenance. The selected Alternative, GW-4, will incorporate a higher mass removal rate of contaminants in ground water by specifying extraction wells in source areas. These are not included in other ground water alternatives, and are expected to provide for remediation of the contaminant plume in a shorter time than GW-3. A review (within 5-years) of the remedial alternative will be conducted to evaluate the effectiveness and ability of the alternative to remediate the ground water to levels below MCLs.

2.8.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion considers the anticipated performance of specific treatment technologies an alternative may employ.

Soil

Alternative SA-1 would not reduce toxicity, mobility, or volume of waste. Alternative SA-2 would use containment rather than treatment to address contaminants in the soil; therefore, toxicity and volume of material would not be reduced. However, mobility of both the contaminants in the soil (cover) and the ground water (barrier wall and extraction wells) would be minimized. Alternatives SA-3, SA-8 (Option 1), and selected Alternative SA-7 all would reduce the toxicity, mobility, volume, of contaminants through permanent, destructive treatment. Under Alternatives SA-6 and SA-8 (Option 2a), VOCs would be transferred from the soil to the air and would not be treated. Contaminated soil under Alternative SA-5 would be disposed of offsite. Under Alternative SA-8, contaminated soil would be left below the water table to be addressed by the selected ground water alternative. Alternative SA-7 will offer the potential for the largest permanent reduction in contaminant mass, as contaminant recovery from the soil column may extend to 30 feet below grade. This is not practical for the excavation/*ex situ* treatment alternatives considered. As stated in CERCLA §121(b), onsite treatment is preferred relative to offsite disposal, containment, and media transfer.

Ground Water

Alternative GW-1 would not reduce toxicity, mobility, or volume of contaminated ground water. Alternatives GW-2, GW-3, and selected Alternative GW-4 would reduce the toxicity, mobility, and volume of contaminated ground water through extraction and treatment. Selected Alternative GW-4 will provide the highest level of reduction by incorporating source area ground water extraction wells into the alternative.

2.8.5 Short-term Effectiveness

This criterion considers the effectiveness of alternatives in maintaining protection of human health and the environment during the construction of a remedy until remedial response objectives have been met.

Soil

All alternatives other than the No Action alternative have the potential to expose onsite workers and nearby persons to fugitive dust and incidental VOC emissions during construction, especially during activities such as excavation and consolidation of contaminated material. Alternatives SA-2 and SA-7 would pose less exposure risk of this type because excavation of VOC-contaminated soil would not be required. Alternatives SA-3, 6, 7, and 8 (Option 1, 2a, and 2b) would require air emission monitoring to ensure that VOC emissions would remain within acceptable levels. Personal protective equipment and engineering controls could be use to mitigate potential worker exposures. Overall, selected Alternative SA-7 will provide the highest level of short-term effectiveness because VOC-contaminated soil will be addressed *in situ* and will not cause significant releases to the atmosphere during handling. Alternatives SA-2 and SA-5 would require 6-9 months to install. SA-3 and SA-7 would require 12-18 months, and SA-6 would require 24 months to install. The implementation time of Alternative SA-8 would vary according to the treatment technology selected, but would require less time than other alternatives specifying similar treatment approaches.

Ground Water

The No Action Alternative and Alternative GW-2 would not present short-term risk to workers or nearby residents from construction activities since no new remedial measures would be constructed or installed. However, GW-2 would not prevent ground water containing chemicals above MCLs from moving off-Post. In general, short term threats associated with the implementation of alternatives GW-3 and GW-4 would be similar and would be addressed by the use of appropriate personal protective equipment for construction personnel. It is not anticipated that LCAAP workers or nearby residents would be exposed to site related contaminants during construction of either of these alternatives.

2.8.6 Implementability

This criterion considers the administrative and technical feasibility of implementing the alternatives and the availability of necessary goods and services for implementation of the response action.

Soil

There are no implementability concerns for Alternative SA-1. Alternative SA-2 would require a predesign study to determine compatibility of the barrier wall material and contaminants in the soil. SA-2 would be difficult to implement because the depth of the barrier wall required (90-

100 feet) is beyond the depth where standard construction methods can be used. Alternatives SA-3, 6, and 7 and the associated options under Alternative SA-8 would require treatability studies to determine optimum operational parameters. Alternative SA-3 could be the most difficult of these alternatives to implement due to administrative issues in siting an LTTD treatment unit. Alternative SA-6 may require air controls that would make it more difficult to implement. Alternative SA-5 would require hauling waste offsite and complying with DOT requirements. Selected Alternative SA-7 will require phasing during implementation for the removal of lead, cover placement, and MPVE installation.

Ground Water

Institutional controls would be implemented for all alternatives other than No Action. There would be no active measures to implement under alternatives GW-1 and GW-2. Alternatives GW-3 and GW-4 would be equally implementable, the only difference being the installation of shallow wells and/or trenches as part of GW-4. The ground water treatment plant, a significant element of both GW-3 and GW-4 is already constructed and operational.

2.8.7 Cost

This criterion considers the capital and O&M costs associated with each of the alternatives. Costs were developed using Means Building Cost Index, vendor estimates, and contractor experience. Alternatives are evaluated for cost in terms of both capital costs and long-term O&M costs necessary to insure continued effectiveness of the alternatives. Capital costs include the sum of the direct capital costs (materials and labor) and indirect capital costs (engineering, licenses, permits). Long-term O&M costs include labor, materials, energy, equipment replacement, disposal, and sampling necessary to ensure the future effectiveness of the alternative.

The objective of the cost analysis is to evaluate each of the alternatives based on their ability to protect human health and the environment for additional costs that may be incurred. Costs vary between the alternatives as a result of differences in the amount of materials and the level of effort required for each alternative. The least costly alternatives for both soil and ground water alternatives are the No Action alternatives.

The following cost tables provide a summary of expected costs for soil and ground water alternatives. The detailed cost basis is provided in the FS and Administrative Record. As summarized in Section 2.11, Documentation of Significant Changes, the costs for the selected soil alternative increased from those presented in the Proposed Plan. The cost increase is a result of FFA parties agreeing on lead management protocol for Area 18 and a decision to install the vapor extraction system to deeper soil depths. The cost increase is offset by the enhancement of mass removal at deeper soil depths (30 feet as opposed to 10 feet bgs) and keeps the selected alternative competitive when compared to other options.

Soil

Alternative SA-1 (No Action)	
Total Capital Costs	$0
30-Year Present Value for Annual Costs Annual Cost = $0 Years = 30 Discount Rate = 5%	$0
TOTAL 30-Year Present Value	**$0**
Alternative SA-2 (Multi-Layer Cover and Vertical Barriers)	
Total Capital Costs	$4,250,000
30-Year Present Value for Annual Costs Annual Cost = $122,000 Years = 30 Discount Rate = 5%	$1,875,000
TOTAL 30-Year Present Value	**$6,125,000**
Alternative SA-3 (Onsite Low Temperature Thermal Desorption)	
Total Capital Costs	$10,130,000
30-Year Present Value for Annual Costs Annual Cost = $5,000 Years = 30 Discount Rate = 5%	$77,000
TOTAL 30-Year Present Value	**$10,210,000**

Alternative SA-5 (Excavation and Offsite Treatment and Disposal)	
Total Capital Costs	$25,700,000
30-Year Present Value for Annual Costs $5,000 Years = 30 Discount Rate = 5%	$77,000
TOTAL 30-Year Present Value	**$25,780,000**
Alternative SA-6 (Excavation and *Ex-Situ* Landfarming)	
Total Capital Costs Option 1 Option 2	$4,690,000 $9,040,000
30-Year Present Value for Annual Costs (same for Option 1 and 2) Annual Cost = $5,000 Years = 30 Discount Rate = 5%	$77,000
TOTAL 30-Year Present Value Option 1 **Option 2**	**$4,770,000** **$9,120,000**
Alternative SA-7 (Soil Vapor Extraction and Treatment)	
Total Capital Costs	$3,210,000
30-Year Present Value for Annual Costs (same for Option 1 and 2) Annual Cost for Cover Portion = $4,600 Years = 30 Annual Cost for MPVE System = $647,500 Years = 5 Discount Rate = 5%	$2,874,000
TOTAL 30-Year Present Value	**$6,084,000**
Alternative SA-8 (Selective Excavation/Treatment or Disposal)	
Total Capital Costs Option 1 Option 2a Option 2b Option 3	$4,150,000 $1,920,000 $5,490,000 $10,690,000
30-Year Present Value for Annual Costs (same for all options) Annual Cost = $5,000 Years = 30 Discount Rate = 5%	$77,000
TOTAL 30-Year Present Value Option 1 **Option 2a** **Option 2b** **Option 3**	**$4,227,000** **$1,997,000** **$5,567,000** **$10,767,000**

Ground Water

Alternative GW-1 (No Action)	
Total Capital Costs	$0
30-Year Present Value for Annual Costs Annual Cost = $0 Years = 30 Discount Rate = 5%	$0
TOTAL 30-Year Present Value	**$0**
Alternative GW- 2 (Limited Ground Water Extraction/Ground Water Monitoring/Point-of-Use Treatment)	
Total Capital Costs	$12,000
30-Year Present Value for Annual Costs Annual Cost = $119,300 Years = 30 Discount Rate = 5%	$1,834,000
TOTAL 30-Year Present Value	**$1,846,000**
Alternative GW-3 (Extraction Wells/Air Stripping/Catalytic Oxidation/Discharge)	
Total Capital Costs	$3,637,000
30-Year Present Value for Annual Costs Annual Cost - Years 1-5= $636,000 Annual Cost - Years 6-30=$580,000 Years = 30 Discount Rate = 5%	$1,474,000
TOTAL 30-Year Present Value	**$12,800,000**
Alternative GW-4 (Extraction Wells (One Deep and Four Shallow) Air Stripping/Catalytic Oxidation/Discharge)	
Total Capital Costs	$4,011,000
30-Year Present Value for Annual Costs Annual Cost = $691,500 Years = 30 Discount Rate = 5%	$10,622,000
TOTAL 30-Year Present Value	**$14,630,000**

2.8.8 Regulatory Acceptance

This criterion considers the support agencies preferences or concerns about the alternatives.

EPA and the State concur with the selected remedy, SA-7 and GW-4, as evidenced by their review comments and acceptance of the RI/FS and Proposed Plan.

2.8.9 Community Acceptance

Comments offered by the public were used to assess whether the proposed alternative was acceptable to the community. The Army received no written comments during the public comment period of 14 April 1997 through 14 May 1997. Questions were posed to the Army regarding the selected remedy during the public meeting held on 22 April 1997. There were no objections to the selected remedial alternative expressed at the meeting. Questions about the remedy posed during the public meeting appeared to be satisfactorily addressed during the meeting. The questions and concerns of the community are discussed in the Responsiveness Summary, which is Appendix E of the ROD. Based on the nature of the public response, the remedy described in the Proposed Plan is acceptable to the community.

2.9 SELECTED ALTERNATIVE

Based on the requirements of CERCLA, comparative analysis using the nine criteria, public comments, and in consultation with EPA and the State, the Army has determined that the selected alternative for the Area 18 OU is Soil Alternative SA-7 (Soil Vapor Extraction and Treatment) in combination with Ground Water Alternative GW-4 (Ground Water Extraction and Treatment). The selected remedies meet the RAOs for the Area 18 OU which are:

- Prevent human contact with soil with lead concentration greater than 1,000 ppm.
- Prohibit agricultural (e.g., cattle grazing) and other non-industrial uses at Area 18.
- Prevent future industrial workers from inhaling VOCs from surface soil.
- Reduce ecological receptor risk from exposure to metals in surface soil.
- Prevent ingestion and dermal contact (future workers) with onsite ground water above regulatory standards.
- Prevent ground water contaminated above regulatory standards from migrating off the Installation.
- Minimize contaminant migration from soil to ground water.

The selected remedies meet these objectives through a combination of treatment of principal threat wastes, excavation or containment of low-level threat wastes, and institutional controls restricting land and ground water use.

Major components of Alternative SA-7 for Soil are:

- In areas where surface soil lead concentrations are above 1,000 ppm and VOCs are present in the soil at concentrations below the RG of 10 ppm, soil will be

excavated to a maximum depth of 2 feet and disposed of in an approved repository.

- Installation of a 24-inch thick vegetated soil cover over soil containing VOCs at concentrations exceeding 10 ppm.
- Install an *in situ* MPVE system to remove VOC mass from the soil that exceeds RGs and minimize exposure to VOC contamination in the surface soils.
- Onsite treatment of vapor extracted from the MPVE wells using thermal/catalytic oxidation, a vapor phase carbon adsorption unit, or other technology determined during remedial design.
- Onsite treatment of ground water extracted from the system and discharged at levels meeting LBVSD discharge limitations.
- Restore any excavations to grade to promote positive drainage.
- Institutional controls.
- Long-term monitoring.
- Cost to implement SA-7: Capital Cost of $3,210,000 (based on estimate provided by USACE) and O&M Cost of $674,500 per year for 5 years (the maximum expected duration of MPVE) for the MPVE system and $71,000 per year for 30 years for maintenance of the cover. Estimated total 30-year present worth cost is $6,084,000.

Excavation and Earth Cover over Lead and VOC-contaminated Soil

Surface soil (0-2 feet) containing lead above cleanup levels (1,000 ppm) will be excavated and disposed of in an approved repository unless it is collocated in an area with VOCs present in the surface soil above the 10 ppm VOC RG. In the areas where lead is collocated with VOCs exceeding RGs and MPVE will be implemented, lead above 1,000 ppm will be managed onsite beneath a 2-foot soil cover as described below. Excavated areas will be restored to grade. A predesign study will further refine the lead-contaminated areas to be excavated.

Areas with VOCs exceeding 10 ppm will be remediated using a MPVE system. Prior to installation of the system, a 2-foot vegetated soil cover will be placed over these areas to enhance performance of the MPVE system by minimizing potential short circuiting of soil vapors. The soil cover will also eliminate exposure to lead in surface soils that is collocated with VOCs exceeding 10 ppm.

MPVE

MPVE will be implemented in all areas where VOCs in soil exceeds the RG of 10 ppm. The MPVE system is a multi-phase system that will extract contaminant vapors from the soil as well as ground water from the pore spaces of the contaminated soil. A key element of the multi-phase system is the extraction of shallow ground water to depress the water table and allow extraction of vapor phase contaminants from soils to a greater depth. A pre-remedial design evaluation acceptable to the Army, EPA, and State of Missouri will be performed to determine the final number and location of extraction wells required to remediate the soil. Based on the results of the predesign study, multi-phase SVE wells will be located to remove vapors and shallow ground water contaminated with VOCs.

SVE technology is both an innovative and presumptive *in situ* remedial technology for treatment of VOC-contaminated soil. Closure criteria are difficult to establish before full-scale operation of the system is implemented. Although pilot testing of the system suggests rapid mass removal, a monitoring program must be developed and implemented during the remedial action to evaluate long-term removal rates. An O&M plan will be developed for operation of the SVE system consistent with the FFA terms. The O&M program will include development of standard operating procedures (SOPs) to provide for monitoring, inspections, repairs, and system shutdown. It will be subject to the approval of the FFA parties and the data will be used by the FFA parties as a decision point for terminating or continuing operation of the system.

Semiannual technical reviews will accommodate the development of appropriate criteria for measuring performance and shutting down the system. SVE system performance data will be made available to the FFA parties for evaluation at a minimum of six months after the system begins operation. Criteria will include, but not be limited to, evaluation of mass recovery rates, cost-effectiveness, and reduction of soil contamination levels. System operation will be determined based on the evaluation of these criteria. As full-scale performance data is collected, information on physical limitations of the site and the benefits of this mass removal system will be better developed and used to determine continued operation of the system. System enhancements (e.g., soil fracturing or horizontal well installation) will be evaluated prior to system shut down. Termination of the system will occur only with the approval of the FFA parties.

Treatment of Extracted Vapors and Ground Water

Vapors removed by the MPVE system will be treated to meet ARARs. Extracted ground water will be treated to meet LBVSD pre-treatment discharge limitations.

Institutional Controls and Monitoring

Institutional controls will be implemented to restrict future uses of the site to industrial uses, preventing the use of the site for cattle grazing, other agricultural activities, and construction of residential housing. Institutional controls would include: (1) issuing a continuing order to restrict

onsite worker access to contaminated soil; (2) filing a notice to the deed detailing the restrictions of the continuing order; and (3) a covenant to the deed in the event of property transfer.

Monitoring of the treatment systems will be conducted to ensure that treatment goals are being met and that air emissions do not exceed acceptable levels.

Major components of the Ground Water Alternative are:

- Continued operation of a ground water extraction well (EW-1) in HSU2. This well was installed as a component of the 1995 removal action.
- Continued operation of well 17-FF for use in ground water remediation.
- Installation of shallow ground water extraction wells or ground water extraction trenches in the vicinity of the source area. For cost purposes, it is estimated that four shallow extraction wells will be required; however, the final number will be determined during remedial design
- Onsite treatment of extracted ground water using an air stripping unit equipped with catalytic oxidation off-gas treatment. This treatment plant has been constructed as a part of the removal action and is currently operational.
- Discharge of treated ground water to the LBVSD at levels at or below established limits. The current limits are presented in Appendix C.
- Quarterly monitoring of the treatment system effluent.
- Institutional controls.
- Long-term ground water monitoring for VOCs to evaluate the performance of the ground water remediation system. Monitoring will be conducted to evaluate possible plume migration beyond its currently understood boundaries, and to evaluate remediation of the plume within the area known to be contaminated.
- Cost to implement GW-4: Capital Cost of $4,011,000 and O&M Cost of $691,500 per year for 30 years. Estimated total 30-year present worth cost is $14,630,000.

Ground Water Extraction, Treatment, and Discharge

Ground water will be removed using system components implemented as part of the removal action at Area 18. EW-1 is expected to be operated at approximately 380 gpm, 17-FF at 90 gpm, and the four shallow wells at an aggregate rate of 50 gpm. Actual pumping rates will be determined using capture zone data once the system is operational. The system will be adjusted to operate so the minimum amount of ground water can be removed and treated while still

containing the VOC plume within the Installation boundary. Well 17-FF will no longer be used as a water supply well and will solely be used for ground water remediation.

Removed ground water will be treated using an onsite air stripper equipped with off gas treatment using a catalytic oxidation unit. Treated ground water will be discharged to the LBVSD. Effluent from the treatment system is currently monitored weekly to insure that treatment goals are being met. Effluent monitoring will continue at intervals sufficient to determine if treatment goals are being met. Ground water will be extracted and treated so RGs (MCLs) will be met at the Installation boundary. MCLs may be met throughout Area 18; however, due to site conditions and technical limitations it may not be practical to meet MCLs onsite, particularly in the tight soils in the source area.

Institutional Controls

Institutional controls will be implemented to restrict future uses of the site to industrial uses and to prevent the use of untreated ground water extracted from contaminated areas within Area 18. Institutional controls will include: (1) issuing a continuing order (by the Installation Commander) to restrict or place limitations on the installation of any new ground water supply wells; (2) filing a notice in environmental and real estate records at the Installation, detailing the restrictions of the continuing order and ground water well restrictions; and (3) compliance with the provisions of CERCLA Section 120(h)(3) or other applicable statutory requirements in the event of property transfer.

Long-term Monitoring

A long-term monitoring program will be developed and implemented as a component of the remedial action and is subject to approval of both EPA and MDNR. Contaminant concentrations in the ground water will be monitored to evaluate the effectiveness of the remediation system and to determine if contaminants in the ground water are migrating beyond the capture zone of the remediation system. If it is determined that contaminants in the ground water are moving offsite, modifications to the remediation system will be implemented to ensure effective plume containment within LCAAP boundaries.

A five-year review will be conducted to evaluate the effectiveness of the remediation system. RGs and the remedial alternative will be reevaluated at that time to ensure that the system is operating effectively and as efficiently as possible. Long-term monitoring will continue until State of Missouri Ground-Water Quality Standards and Federal MCLs are met.

2.10 STATUTORY DETERMINATIONS

In accordance with the statutory requirements of Section 121 of CERCLA, remedial actions that are selected are required to:

- Protect human health and the environment

- Comply with applicable or relevant and appropriate requirements (ARARs)
- Be cost effective
- Use permanent solutions and alternative treatment technologies to the maximum extent practicable
- Satisfy the preference for treatment that reduces contaminant toxicity, mobility, or volume as a principal element

The manner in which the Area 18 remedial action satisfies the above requirements is discussed in the following sections.

The selected remedy will be reviewed, at a minimum, every five years as specified in CERCLA 121(c) because hazardous substances will remain on-site after the remedy is implemented.

2.10.1 Protection of Human Health and the Environment

Soil

The selected remedy addresses health and environmental issues that were identified in the Area 18 OU RI and Baseline Risk Assessment. Specifically, the soil vapor extraction and treatment alternative:

- Eliminates exposure to lead (above 1,000 ppm) and other metals and VOCs in the surface soil by excavating, disposing, and/or constructing a cover over these soils.
- Reduces the volume of VOCs in the subsurface soil which may ultimately migrate to ground water.
- Uses institutional controls to prevent agricultural and other non-industrial uses of the site.

The selected soil remedy will meet remedial action objectives for soil and reduce and maintain cumulative risk within the 10^{-4} to 10^{-6} risk range.

Ground Water

The selected remedy addresses health and environmental issues that were identified in the Area 18 OU RI and Baseline Risk Assessment. Specifically, the ground water extraction and treatment alternative:

- Reduces potential exposures to off-Post receptors by containing contaminated ground water at levels exceeding MCLs within LCAAP boundaries.

- Reduces risk by reducing the concentration of contaminants in the ground water to levels below MCLs.

- Prevents the use of untreated, contaminated ground water extracted from within LCAAP boundaries.

- Provides for long-term monitoring of ground water to identify potential future risks associated with the Area 18 OU and to monitor the effectiveness of the remedial action.

The selected ground water remedy will meet remedial action goals for ground water and reduce and maintain cumulative risk within the 10^{-4} to 10^{-6} risk range.

2.10.2 Compliance with ARARs

There are no chemical-specific ARARs for soil; however, RGs have been established for clean up of soils in the Area 18 OU. Soil RGs are based on levels protective of ground water as calculated using EPA's SUMMERS model and will be evaluated during technical reviews as to their appropriateness. Alternative SA-7 will achieve significant mass reduction of VOCs in the soil. Action and location-specific ARARs will be met, including Clean Air Act and State air quality requirements.

Alternative GW-4 will meet Safe Drinking Water Act MCLs and State Ground Water Quality Standards at the Installation boundary and may meet MCLs in the vicinity of the source area. Offgas emissions from air strippers will be treated to meet requirements of the Clean Air Act and state air quality requirements. Action and location-specific ARARs will be met.

Additional information about ARAR compliance is contained in Section 2.8.2.

2.10.3 Cost Effectiveness

The selected remedy has been determined to provide overall effectiveness in reducing human health risks relative to their costs.

Soil

The 30-year net present worth of Alternative SA-7 is $6,084,000. The estimated cost of the selected remedy is similar to other alternatives, but achieves the best balance of risk reduction and contaminant mass removal.

Ground Water

The net present worth of Alternative GW-4 is $14,630,000. The estimated costs of the selected ground water remedy exceed the estimated costs associated with Alternative GW-3 by

approximately $1,800,000; however, Alternative GW-4 provides for greater contaminant mass removal and an anticipated shorter remediation time frame.

2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Extent Possible

The selected remedy meets the statutory requirement to utilize permanent solutions and treatment technologies to the maximum extent practical for the Area 18 OU. EPA has designated MPVE (a variation of SVE) as a presumptive remedy for removal of VOCs in soil. Ground water extraction and treatment systems have proven effective in remediating and containing contaminated ground water. The selected remedy provides the best balance of tradeoffs among alternatives which are both protective and ARAR-compliant relative to the five primary balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume of contamination; short-term effectiveness; implementability; and cost. Section 2.8 provides a comparative analysis of these criteria relative to each alternative.

The use of MPVE, soil covers, and ground water extraction and containment provide the best balance of contamination removal and cost effectiveness while maximizing reduction in site risks.

The State accepts the selected remedy and has been involved with the RI and remedy selection process. Concerns regarding the development of the alternatives were identified by the State and have been adequately addressed.

Anticipated community concerns were addressed during the development of alternatives. During the public comment period, the community did not identify any additional concerns for the selected remedies.

A five-year review of the selected remedy will be performed since the selected remedy will require an extended time frame to meet cleanup goals. The review will be conducted no less often than every five years after commencement of the remedial action to insure that the remedy continues to provide adequate protection of human health and the environment. During this review, RGs and the selected alternative will be reevaluated to ensure that they remain protective, provide a significant reduction in contamination, are cost effective, and are achievable in a reasonable time frame.

2.10.5 Preference for Treatment as a Principal Element

The selected remedies for soil and ground water both provide treatment as their principal element. Alternative SA-7 uses treatment and/or containment to address the principal threat wastes (VOCs) in the soil in the surface impoundments, and excavation and/or containment to address low level threat wastes (lead) in the surface soil at Area 18. GW-4 uses extraction and treatment to address contaminants in the ground water. Institutional controls will be used for short-term and long-term management of Area 18 to prevent exposure to principal and low level threat wastes and to affected ground water.

2.11 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected action is the same as the preferred alternative presented in the Proposed Plan for the Area 18 OU remedial action. There have been changes relative to the Proposed Plan regarding the handling of lead contaminated surface soil and the costs associated with the selected alternative.

The FFA parties agreed to a lead management protocol for Area 18 that specifically describes how lead-contaminated soil and soil contaminated with both lead and VOCs will be addressed by the remedial action. The preferred alternative in the Proposed Plan indicates that lead concentrations in surface soils greater than 1,000 ppm would be addressed by a soil cover and/or excavation/stabilization and disposal as appropriate. As discussed in the description of the selected soil alternative, SA-7, lead-contaminated soil (0-2 ft) in excess of 1,000 ppm will be excavated and disposed in an appropriate repository or managed under a soil cover if it is collocated with soil containing VOCs in excess of 10 ppm.

The costs for the selected soil alternative increased from those presented in the Proposed Plan. The cost increase is a result of the modified lead management strategy and also by a decision to install the vapor extraction system to greater soil depths. The capital cost for SA-7 was estimated to be approximately $1.5 million in the proposed plan. The estimate of cost for SA-7 in this ROD is approximately $6.0 million. The cost increase is offset by the enhancement in mass removal at greater soil depths (30 feet as opposed to 10 feet bgs). The increase in performance keeps the selected alternative competitive when compared to other alternatives.

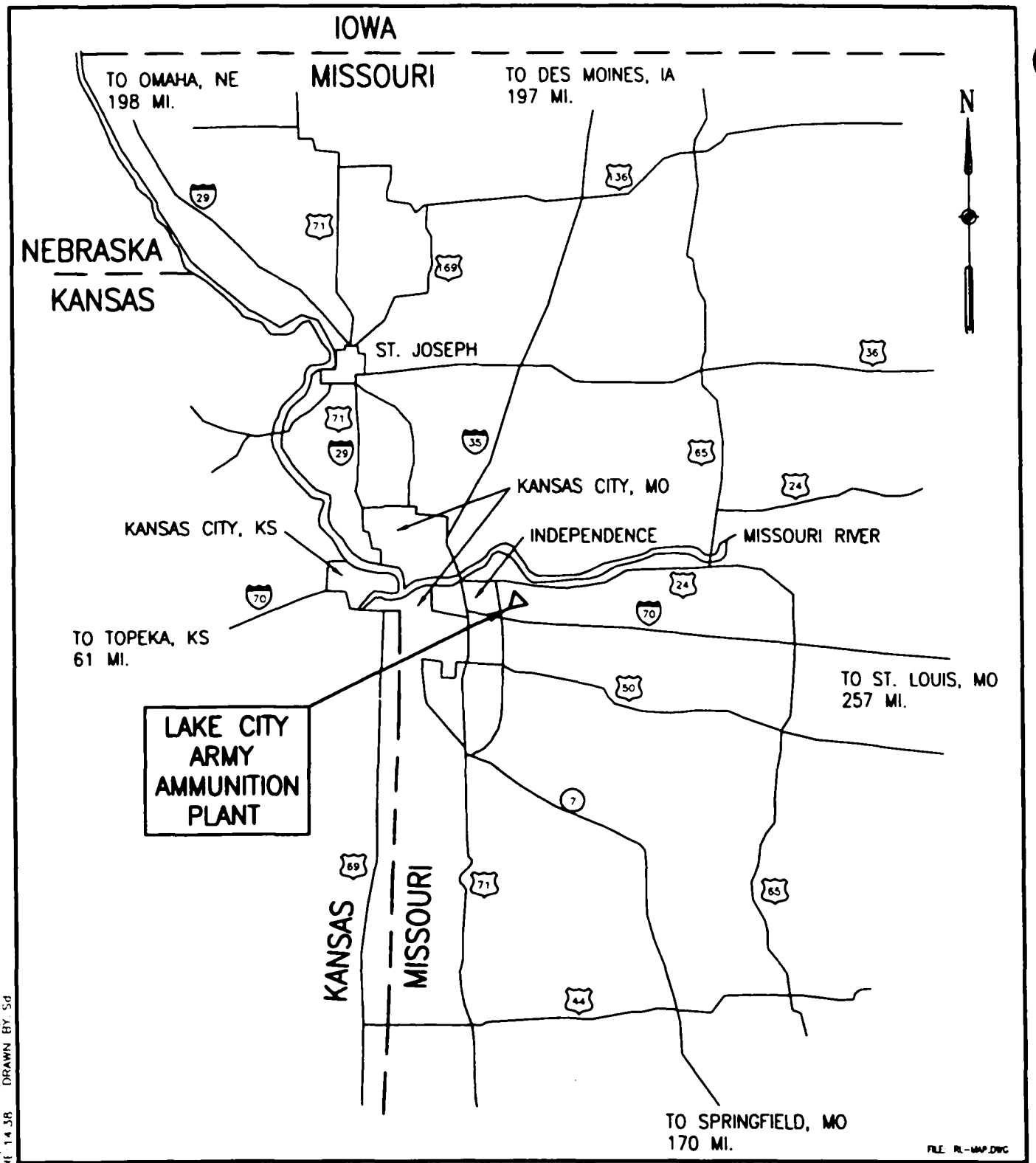
3.0 LIST OF ACRONYMS AND ABBREVIATIONS

AOC:	Area of Concern
ARARs:	Applicable or Relevant and Appropriate Requirements
BLRA:	Baseline Risk Assessment
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
COC:	Chemical of Concern
DCE:	Dichloroethene
DNAPL:	Dense Non-Aqueous Phase Liquid
EPA:	Environmental Protection Agency
FFA:	Federal Facility Agreement
GW:	Ground Water
HI:	Hazard Index
HQ:	Hazard Quotient
IRP:	Installation Restoration Program
IWOU:	Installation-Wide Operable Unit
IWTP:	Industrial Wastewater Treatment Plant
LBVSD:	Little Blue Valley Sewer District
LCAAP:	Lake City Army Ammunition Plant
LDR:	Land Disposal Restrictions
LTTD:	Low Temperature Thermal Desorption
MCL:	Maximum Contaminant Level
MDNR:	Missouri Department of Natural Resources
μg/L:	Micrograms per liter
mg/L:	Milligrams per liter
MPVE:	Multi-Phase Vapor Extraction
NCP:	National Oil and Hazardous Substances Contingency Plan
NECOU:	Northeast Corner Operable Unit
NPL:	National Priorities List
O&M:	Operations and Maintenance
OU:	Operable Unit
PCE:	Perchloroethylene; liquids used in degreasing or paint removal.
ppm:	Parts per million by weight
RAO:	Remedial Action Objective
RCRA:	Resource Conservation and Recovery Act
RfD:	Reference Dose

RG:	Remediation Goal
RI/FS:	Remedial Investigation/Feasibility Study
RME:	Reasonable Maximum Exposure
ROD:	Record of Decision
SA:	Soil Alternative
SARA:	Superfund Amendments and Reauthorization Act
SACM:	Superfund Accelerated Cleanup Model
SF:	Slope Factor
SVE:	Soil Vapor Extraction
SVOC:	Semivolatile Organic Compound
TCA:	1, 1, l,-tetrachloroethane
TCE:	Trichloroethylene
TCLP:	Toxicity Characteristic Leaching Procedure
VOC:	Volatile Organic Compound

APPENDIX A

FIGURES



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

DEPARTMENT OF THE ARMY
LCAAP
LAKE CITY, MISSOURI

REGIONAL LOCATION MAP
LCAAP - AREA 18 OU

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE NO.
GAT	JDK	PMS	JDK	NONE	DEC 97	60984.01	1

DRAWING NAME: F:\PROJ\124209\FIGURES\RL_MAP
DATE: 02/17/1997 TIME: 14:38 DRAWN BY: Sd

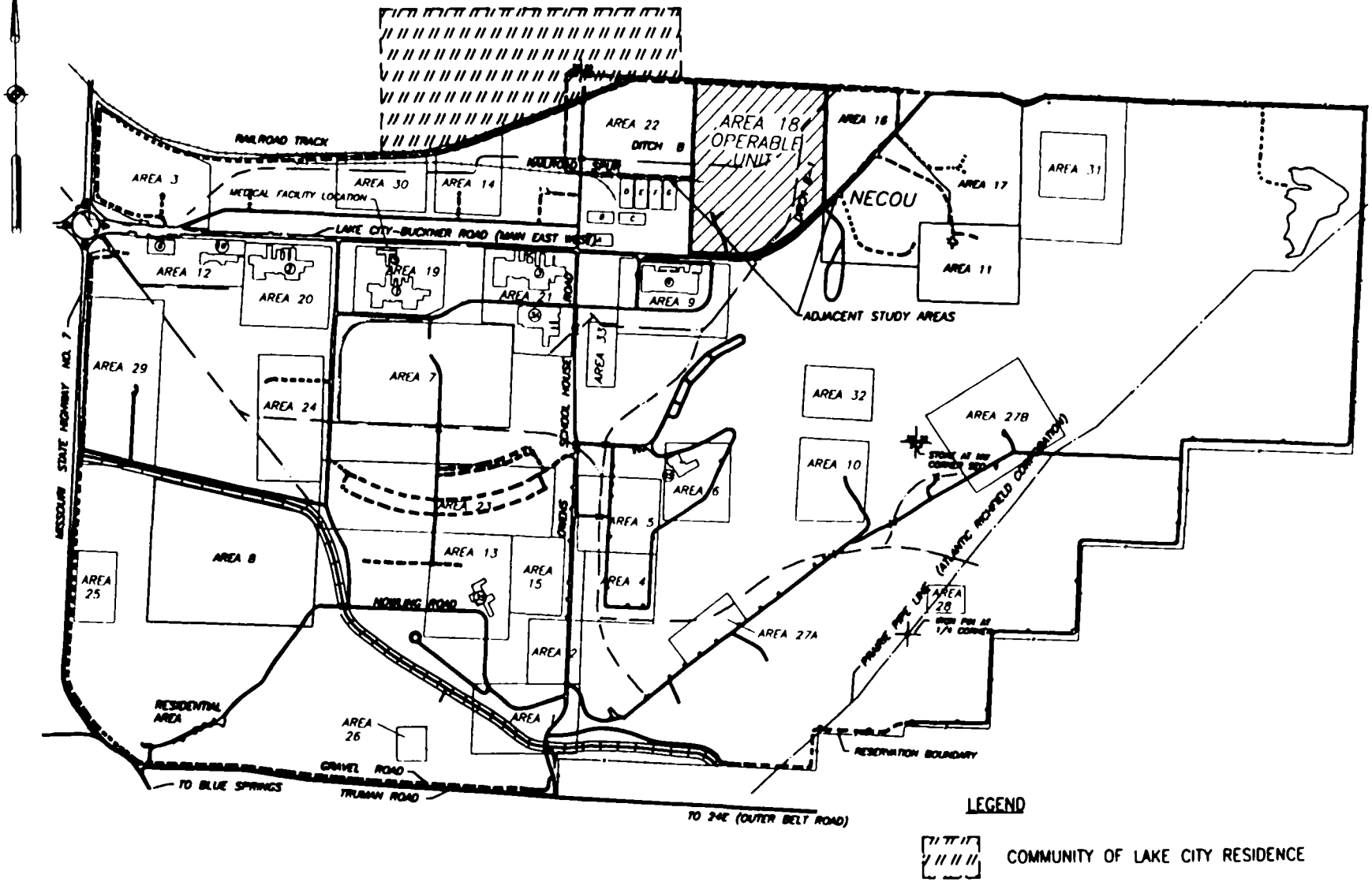


FIGURE 2 AREA 18 LOCATION MAP

DRAWING NAME: F:\PROJ\609840\FIGURES\ILLUST-1
DATE:07/14/1997 TIME:14:26 DRAWN BY: Sd

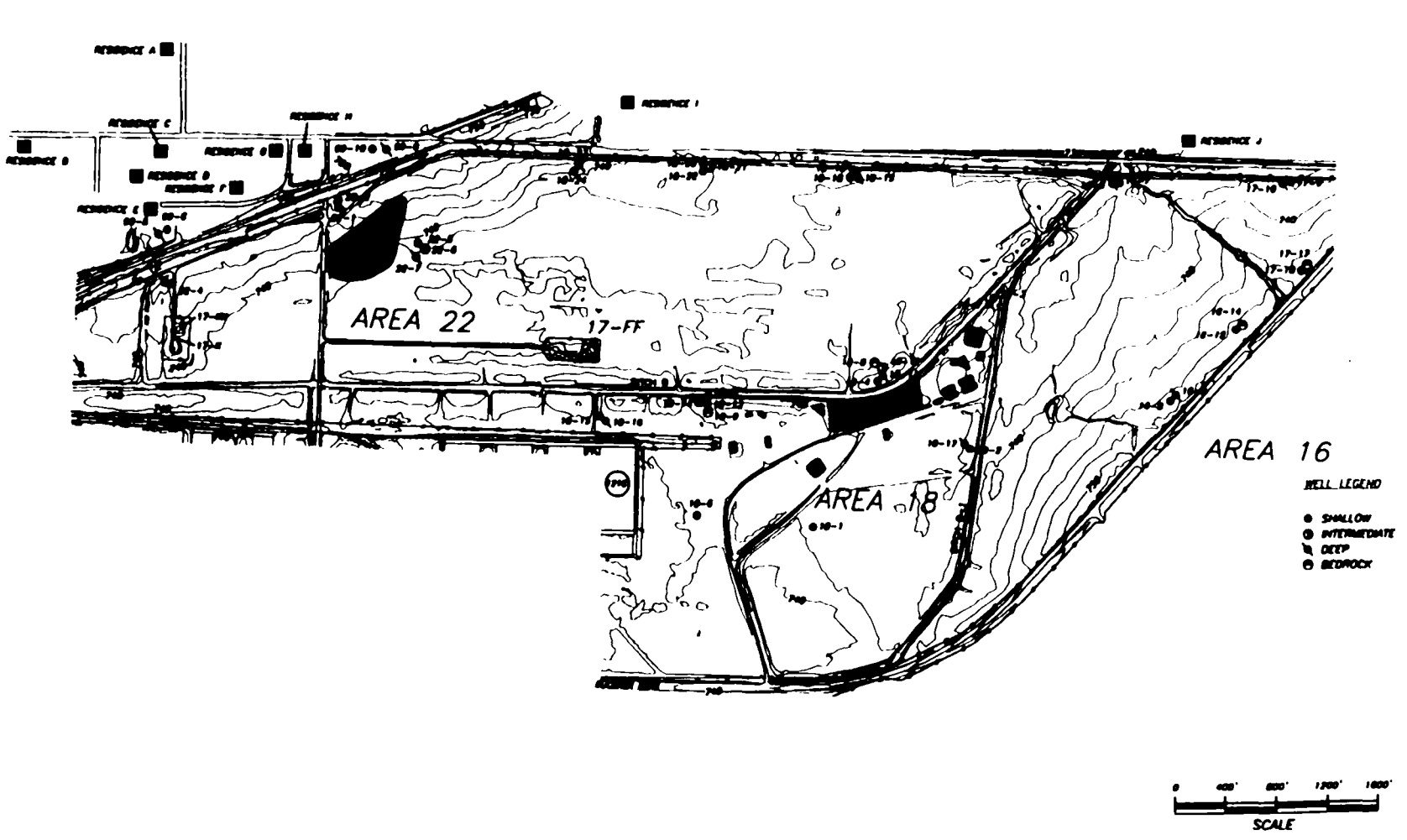


FIGURE 3 AREA 18 SITE MAP

DRAWING NAME: F:\PROJ\5098401\FIGURES\18-SITE
DATE:07/14/1997 TIME:15:37 DRAWN BY: Sd

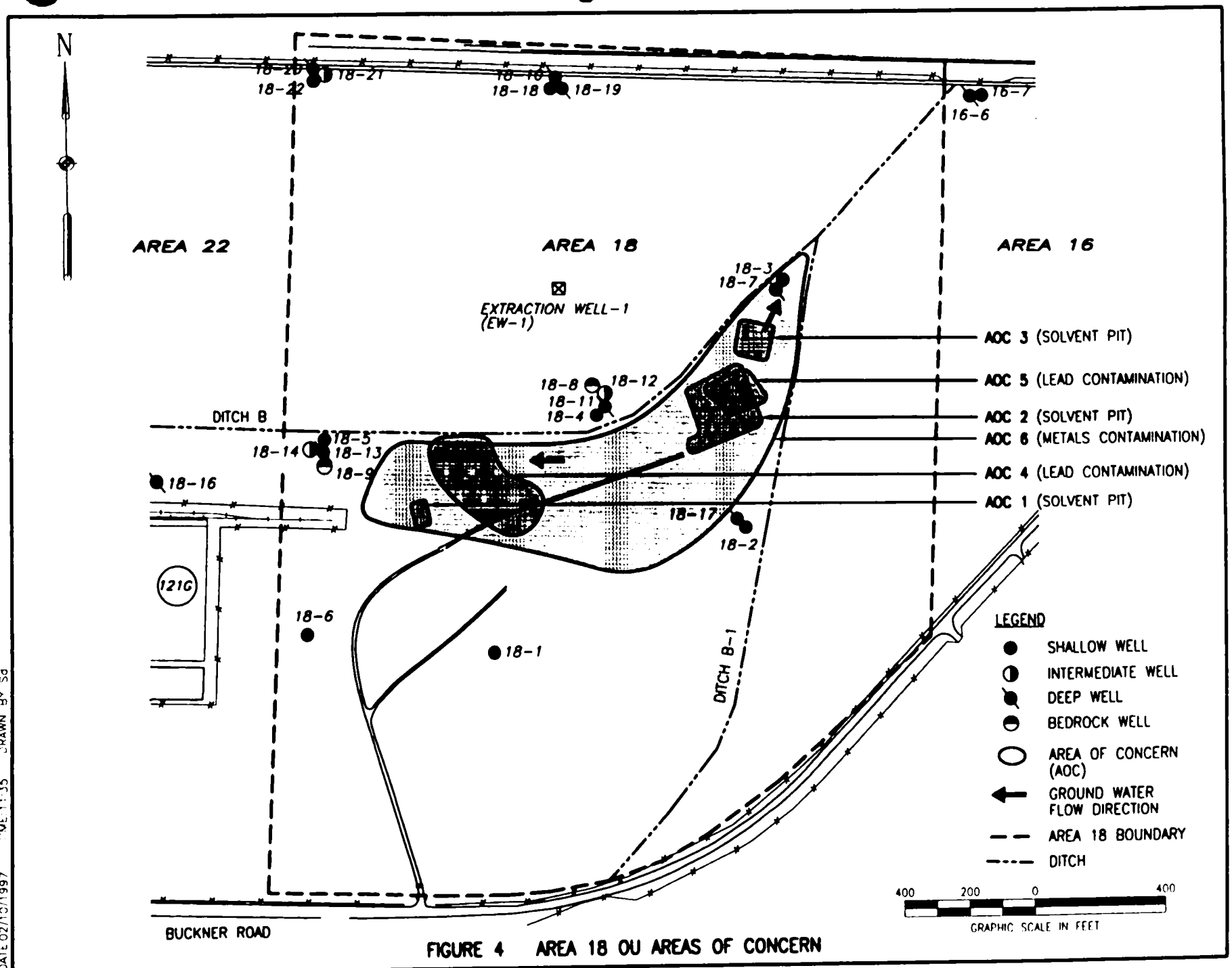


FIGURE 4 AREA 18 OU AREAS OF CONCERN

DRAWING NAME: F:\PROJ\609840\FIGURES\LUST-3
DATE: 02/10/1997 TIME: 11:35 DRAWN BY: Sd

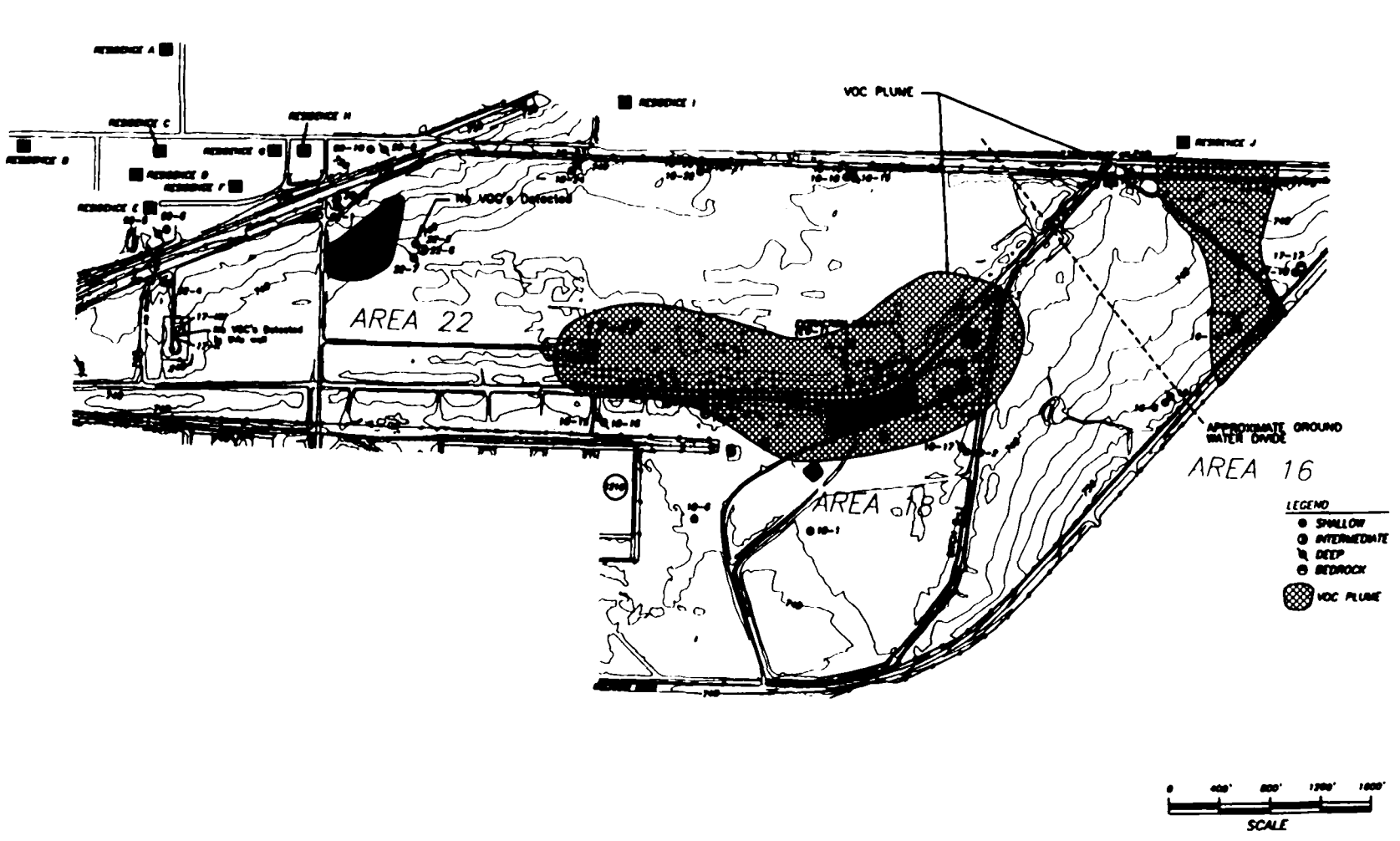
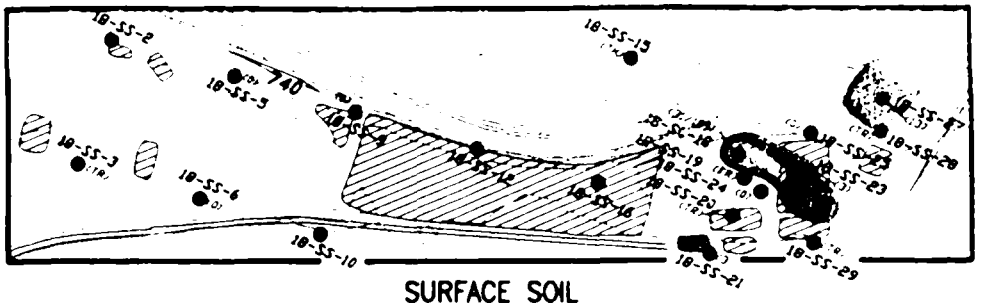


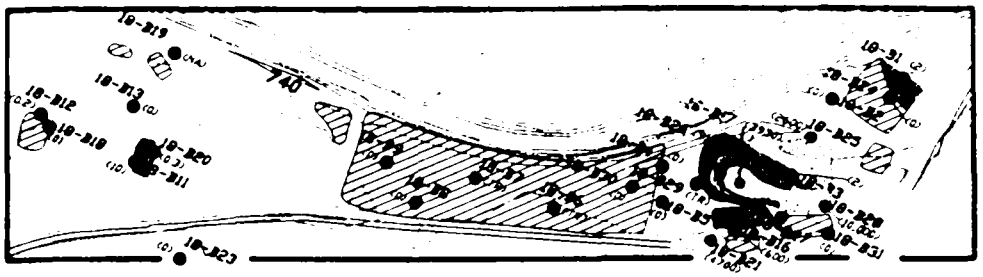
FIGURE 5 AREAL EXTENT OF GROUND WATER CONTAMINATION

DRAWING NAME: F:\PROJ\6098401\FIGURES\18-VOC.DWG
DATE:12/01/1997 TIME:10:04 DRAWN BY Sd



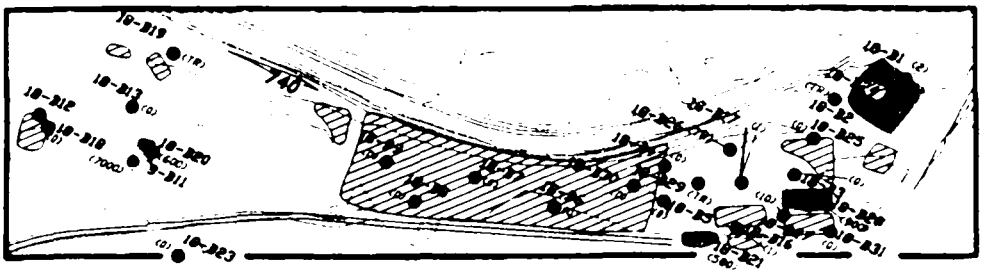
SURFACE SOIL
CL 0–0.5'

TOTAL VOLUME OF SOIL = 460 yd³
MASS OF CONTAMINANT = 24 lb
AVERAGE CONCENTRATION = 18 ug/g



TEST BORINGS
CL 0.5'–2.5'

VOLUME OF CONTAMINATED SOIL = 2184 yd³
MASS OF CONTAMINANT = 12584 lb
AVERAGE CONCENTRATION = 1922 ug/g



TEST BORINGS
CL 2.5'–5.0'

VOLUME OF CONTAMINATED SOIL = 1500 yd³
MASS OF CONTAMINANT = 3700 lb
AVERAGE CONCENTRATION = 825 ug/g

SUM OF TOTAL CHLORINATED COMPOUNDS (ug/g):

- 1–10
- 10–100
- 100–1000
- 1000–10000

300 0 300

SCALE

NO SIGINIFICANT DATA HAS BEEN COLLECTED BELOW 13 FEET BGS

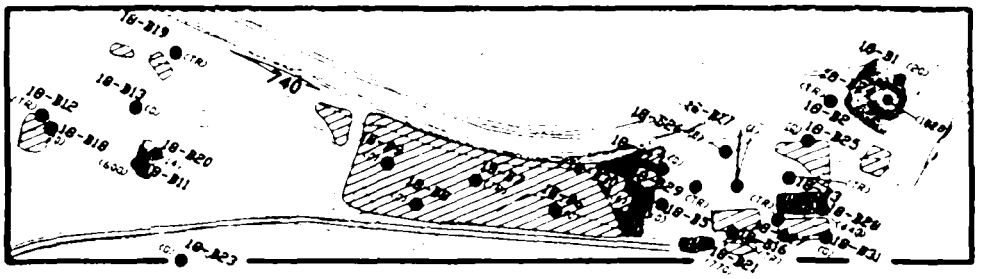
DRAWING NAME: F:\PROJ\609R401\FIGURES\PAGE1.DWG
DATE 12/03/1997 TIME 13:30 DRAWN BY Sd

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

DEPARTMENT OF THE ARMY
LCAAP
LAKE CITY, MISSOURI

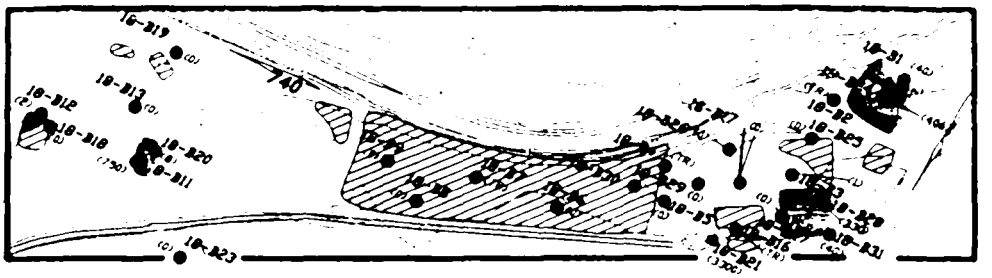
VOC CONCENTRATIONS IN SOURCE AREA SOILS (SOLVENT PITS) – SURFACE TO 5'

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
TER	RJK	PMS	KW	1" = 300'	DEC 97	12422.08	6



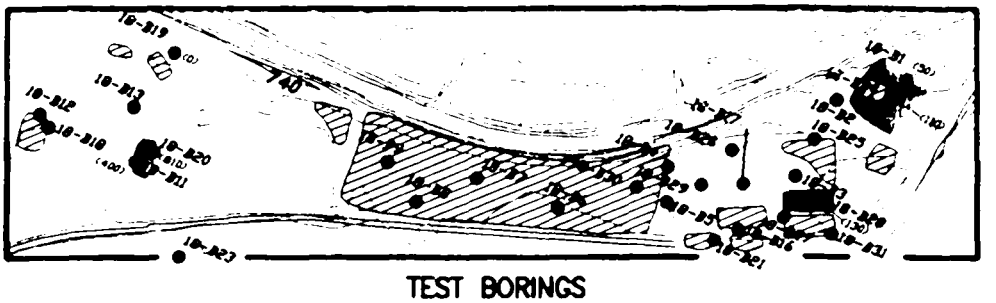
TEST BORINGS
CL 5.0'–7.5'

VOLUME OF CONTAMINATED SOIL = 1545 yd³
MASS OF CONTAMINANT = 2156 lb
AVERAGE CONCENTRATION = 485 ug/g



TEST BORINGS
CL 7.5'–10.0'

VOLUME OF CONTAMINATED SOIL = 1805 yd³
MASS OF CONTAMINANT = 4312 lb
AVERAGE CONCENTRATION = 798 ug/g



TEST BORINGS
CL 10.0'–12.5'

VOLUME OF CONTAMINATED SOIL = 1405 yd³
MASS OF CONTAMINANT = 350 lb
AVERAGE CONCENTRATION = 83 ug/g

SUM OF TOTAL CHLORINATED COMPOUNDS (ug/g):

- 1–10
- 10–100
- 100–1000
- 1000–10000

* Additional 2050 lbs. at 12.5–15.0 in pit 57–L1–69

300' 0 300'

SCALE

NO SIGINIFICANT DATA HAS BEEN COLLECTED BELOW 13 FEET BGS

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

DEPARTMENT OF THE ARMY
LCAAP
LAKE CITY, MISSOURI

VOC CONCENTRATIONS IN SOURCE AREA SOILS (SOLVENT PITS) – 5' TO 12.5'

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
TER	RJK	PMS	KW	1" = 300'	DEC 97	12422.08	7

DRAWING NAME: F:\PROJ\60984\01\FIGURES\PAGE1.DWG
DATE 12/03/1997 TIME 13:30 DRAWN BY Sas

APPENDIX B

TABLES

TABLE 1 COCs AND REMEDIATION GOALS FOR AREA 18 SOIL

Compound	Detection Limit (mg/kg)	Maximum Detection Concentration (mg/kg)	Maximum Background Concentration (mg/kg)	Protection of Groundwater Soil Target Concentration (mg/kg)	Protection of Human Health (mg/kg)	TBC Criteria			Remediation Goals (mg/kg)
						Missouri ASLs[7] (mg/kg)	Other Remedial Criteria (mg/kg)	EPA Region 3/9 (mg/kg)	
Copper	2.7	18,000	30.7	NA	581[1]	-	-	-	581
Mercury	0.050	7.3	<0.1	NA	0.09[1]	17	20[8]	310/610	0.09
Zinc	2.4	7,200	99.5	NA	148.5[1]	5600	-	-	148.5
Lead	1.2	1,600	39.5	---	2,728	240	2,178[5]	-	1,000[6]
1,2- DCE	1.20	934	NA	2.06	NA	560/1,100[9]	-	10,.000/390	10
Toluene	0.005	2,000	NA	180	NA	11,000	20,000[8]	200,000/280	180
PCE	0.005	1,000	NA	1.09	784	380	10[8]	55/0.65	10
TCE	0.005	9,000	NA	0.4	2731[2]/27.3[3]/176[4]	260	60[8]	260/34	10
PAHs	5.0	20.1[10]	NA	660	NA	-	-	-/-	660
Vinyl Chloride	0.010	4.9	NA	0.01	NA[11]	-	-	1.5/0.2	10
Benzene	0.005	0.003	NA	0.25	NA[11]	170	-	99/4.6	99
1,1-DCE	0.005	ND	NA	0.3	NA	8.3	10	4.8/0.12	10

Notes.

1. Ingestion of beef from cattle pastured in Area 18.
2. 10^{-4} cancer risk.
3. 10^{-6} cancer risk.
4. Non-cancer risk (HI=1).

therefore no

5. See Lead Leachability from Soil discussion in FS.
6. Upper 24 inches, based on MDNR recommendations.
7. Withdrawn.
8. Proposed in Federal Register, Friday, July 27, 1990.
9. Cis/trans isomers.
10. Total PAHs less than RG, RG calculated based on Summers Model.
11. These compounds were not detected in surface soil, risks were calculated for these compounds.

F:\PROJ\6098401\POOL\ROD\DFT_FNL\TABLES\TABLE1.WPD
3 May 1995

TABLE 2 VOCS DETECTED IN RI GROUND WATER SAMPLES

Area-Specific Wells	Vinyl Chloride	12DCE	TCE	Toluene	Benzene	11DCE	11DCA	111TCA	PCE
18-4 (shallow)						-/(15)/-			
18-8 (bedrock/deep)	(34)/(2,000)	42/(200)							
18-9 (bedrock/deep)	(150)/(66)	19/		/2.1	4.9/		2.6/		
18-11 (deep)	(95)/(8,000)	/(2,000)	/(14)	/9	/(6.8)	/(18)			
18-12 (intermediate)	(7,000)/(8,000)	(4,000)/(4,000)	/(68)	/23	/(42)	/(35)	/2.3		
18-13 (deep)	/(9.2)	22/	4/						
18-14 (intermediate)	/(58)	(130)/	2.7/(42)						
18-15 (shallow)	(20)/								
18-16 (deep)	(35)/(94)	5.5/							
18-17 (deep)				71[<1.36]/-/1.0					
18-24 (shallow)								0.92	
17-FF	[vinyl chloride 44-370 μg/L over 4-year period (see Appendix 4-D of RI (EA 1995)]								
22-3 (deep)	[12DCE ND-330 μg/L over 4-year period]			55/				0.92/	
16-14 (intermediate)			/1.5						
16-15 (shallow)		48/	/(87)					4.2/2.1	(8.1)/(6.4)

(a) Delimiters indicate first/second/third round (if applicable).
( ) Indicates above MCL.
[ ] Indicates duplicate sample.

Units of measure: μg/L.

TABLE 3 COCS AND REMEDIATION GOALS FOR AREA 18 GROUND WATER

Compound	Maximum Concentration Detected (µg/L)	Remediation Goal (µg/L)	Rationale
1,2-DCE[a]	4,000	70	MCL[b]
Manganese	2,740	NA	MCL
Arsenic	16.8	50	MCL
Vinyl chloride	8,000	2	MCL
1,1-DCE	35	7	MCL
Benzene	42	5	MCL
PCE	8.1	5	MCL
TCE	68	5	MCL

(a) Both cis and trans isomers.
(b) Safe Drinking Water Act Maximum Contaminant Level.

TABLE 4 EXPOSURE GROUPS, EXPOSURE ROUTES, AND RISKS FOR AREA 18[a]

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern[b]	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / Rfd)
Current Lake City Residents[c]	1. Ingestion of Ground-Water	VOCs						
		acetone	3.0 E-04	NA	NA	NA	1 E-01	3 E-03
		benzene	3.0 E-05	1.3 E-05	2.9 E-02	4 E-07	NA	--
		chlorobenzene	2.9 E-05	NA	NA	NA	2 E-02	1 E-03
		chloroform	1.7 E-05	7.6 E-06	6.1 E-03	5 E-08	1 E-02	2 E-03
		chloromethane	9.0 E-05	3.9 E-05	1.3 E-02	5 E-07	NA	--
		1,1-DCE	3.1 E-05	1.3 E-05	6.0 E-01	8 E-06	9 E-03	3 E-03
		TCE	2.4 E-05	1.0 E-05	1.1 E-02	1 E-07	1 E-01	2 E-04
		xylenes (total)	6.5 E-05	NA	NA	NA	2 E+00	3 E-05
		Explosives						
		HMX	4.7 E-05	NA	NA	NA	5 E-02	9 E-04
		RDX	2.2 E-05	9.6 E-06	1.1 E-01	1 E-06	3 E-03	7 E-03
		1,3,5-Trinitrobenzene	7.3 E-06	NA	NA	NA	5 E-05	1 E-01
		Inorganics						
		arsenic	3.9 E-05	1.7 E-05	1.8 E+00	3 E-05	3 E-04	1 E-01
		barium	2.9 E-03	NA	NA	NA	7 E-02	4 E-02
		beryllium	2.0 E-05	8.7 E-06	4.3 E+00	4 E-05	5 E-03	4 E-03
		cadmium	9.2 E-05	4.0 E-05	NA	--	5 E-04	2 E-01
		chromium	2.2 E-04	9.4 E-04	NA	--	5 E-03	2 E-04
		copper	7.8 E-04	NA	NA	NA	4 E-02	2 E-02
		lead	1.5 E-04	6.3 E-05	NA	--	NA	--
		mercury	3.1 E-06	NA	NA	NA	3 E-04	1 E-02
		zinc	3.9 E-03	NA	NA	NA	3 E-01	1 E-02
	PATHWAY TOTAL					8 E-05		6 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	2. Dermal Contact with Ground Water	VOCs						
		acetone	---	NA	NA	NA	NA	--
		benzene	4.0 E-06	1.7 E-06	NA	5 E-08	NA	--
		chlorobenzene	9.7 E-06	NA	NA	NA	NA	5 E-04
		chloroform	1.3 E-06	5.7 E-07	NA	4 E-09	NA	1 E-04
		chloromethane	2.0 E-06	8.5 E-07	NA	1 E-08	NA	--
		1,1-DCE	3.5 E-06	1.5 E-06	NA	9 E-07	NA	4 E-04
		TCE	3.5 E-06	1.5 E-06	NA	2 E-08	NA	3 E-05
		xylenes (total)	4.0 E-05	NA	NA	NA	NA	2 E-05
		Explosives						
		HMX	---	NA	NA	NA	NA	--
		RDX	---	---	NA	--	NA	--
		1,3,5-Trinitrobenzene	---	NA	NA	NA	NA	--
		Inorganics						
		arsenic	7.7 E-08	3.3 E-08	1.8 E+00	2 E-06	3 E-04	3 E-04
		barium	5.7 E-06	NA	NA	NA	7 E-02	8 E-04
		beryllium	4.1 E-08	1.8 E-08	4.3 E+00	7 E-07	5 E-03	8 E-05
		cadmium	1.8 E-07	7.9 E-08	NA	--	5 E-04	4 E-03
		chromium	8.8 E-07	3.8 E-07	NA	--	5 E-03	2 E-04
		copper	1.6 E-06	NA	NA	NA	4 E-02	6 E-05
		lead	1.1 E-09	5.0 E-10	NA	--	NA	--
		mercury	6.3 E-09	NA	NA	NA	3 E-04	3 E-04
		zinc	5.7 E-06	NA	NA	NA	3 E-01	2 E-05
PATHWAY TOTAL						3 E-06		7 E-03

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
	3. Inhalation of VOCs from Ground Water	VOCs						
		acetone	9.0 E-05	NA	NA	NA	1 E-01	9 E-04
		benzene	1.1 E-05	4.8 E-06	2.9 E-02	1 E-07	NA	--
		chlorobenzene	9.6 E-06	NA	NA	NA	5.5 E-03	2 E-03
		chloroform	5.7 E-06	2.4 E-06	8.1 E-02	2 E-07	1 E-02	6 E-04
		chloromethane	3.9 E-05	1.7 E-05	6.3 E-03	1 E-07	NA	--
		1,1-DCE	1.1 E-05	4.6 E-06	1.2 E+00	6 E-06	9 E-03	1 E-03
		TCE	7.3 E-06	3.1 E-06	6.0 E-03	2 E-08	2.9 E-03	3 E-03
		xylenes (total)	2.2 E-05	NA	NA	NA	2 E+00	1 E-05
		Explosives						
		HMX	NONE	NA	NA	NA	5 E-02	NONE
		RDX	NONE	---	NA	NONE	3 E-03	NONE
		1,3,5-Trinitrobenzene	NONE	NA	NA	NA	5 E-05	NONE
		Inorganics						
		arsenic	NONE	NA	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NONE	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		chromium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		copper	NONE	NA	NA	NA	4 E-02	NONE
		lead	NONE	NONE	NA	NONE	NA	NONE
		mercury	NONE	NA	NA	NA	8.6 E-05	NONE
		zinc	NONE	NA	NA	NA	3 E-01	NONE
	PATHWAY TOTAL					6 E-06		7 E-03
	TOTAL FOR CURRENT LAKE CITY RESIDENTS					9 E-05		6 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
Current Lake City Well C Residents[d]	1. Ingestion of Ground-Water	Explosives						
		HMX	7.2 E-05	NA	NA	NA	5 E-02	1 E-03
		RDX	3.6 E-05	1.6 E-05	1.1 E-01	2.6 E-06	3 E-03	1 E-02
		Inorganics						
		arsenic	4.9 E-05	2.1 E-05	1.8 E+00	4.5 E-05	3 E-04	2 E-01
		barium	5.0 E-03	NA	NA	NA	7 E-02	7 E-02
		beryllium	3.0 E-05	1.3 E-05	4.3 E+00	6 E-05	5 E-03	6 E-03
		copper	1.3 E-03	NA	NA	NA	4 E-02	3 E-02
		lead	1.5 E-04	6.6 E-05	NA	--	NA	--
		zinc	5.4 E-03	NA	NA	NA	3 E-01	2 E-02
	PATHWAY TOTAL					9 E-05		3 E-01
	2. Dermal Contact with Ground Water	Explosives						
		HMX	---	NA	NA	NA	NA	--
		RDX	---	---	NA	--	NA	--
		Inorganics						
		arsenic	9.8 E-08	4.2 E-08	1.8 E+00	2 E-06	3 E-04	4 E-04
		barium	9.9 E-06	NA	NA	NA	7 E-02	1 E-03
		beryllium	6.0 E-08	2.6 E-08	4.3 E+00	1 E-06	5 E-03	1 E-04
		copper	2.6 E-06	NA	NA	NA	4 E-02	1 E-04
		lead	1.2 E-09	5.3 E -10	NA	--	NA	--
		zinc	6.5 E-06	NA	NA	NA	3 E-01	3 E-05
	PATHWAY TOTAL					3 E-06		2 E-03

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
	3. Inhalation of VOCs from Ground Water	Explosives						
		HMX	NONE	NA	NA	NA	5 E-02	NONE
		RDX	NONE	---	NA	NONE	3 E-03	NONE
		Inorganics						
		arsenic	NONE	NONE	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NA	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NA	6.1 E+00	NA	5 E-04	NONE
		lead	NONE	NONE	NA	NONE	NA	NONE
		zinc	NONE	NA	NA	NA	3 E-01	NONE
	PATHWAY TOTAL					0		0
	TOTAL FOR CURRENT LAKE CITY WELL C RESIDENTS					1 E-04		3 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
Future Off-Post Residents	1. Ingestion of Ground-Water	VOCs						
		1,2-DCE	2.2 E-03	NA	NA	NA	1 E-01	2 E-01
		TCE	2.5 E-04	1.1 E-04	1.1 E-02	1 E-06	1 E-01	2 E-03
		vinyl chloride	3.9 E-03	1.7 E-03	1.9 E+00	3 E-03	NA	--
	PATHWAY TOTAL					3 E-03		2 E-01
	2. Dermal Contact with Ground Water	VOCs						
		1,2-DCE	1.6 E-04	NA	NA	NA	NA	2 E-02
		TCE	3.6 E-05	1.5 E-05	NA	2 E-07	NA	4 E-04
		vinyl chloride	1.6 E-04	6.9 E-05	NA	1 E-04	NA	--
	PATHWAY TOTAL					1 E-04		2 E-02
	3. Inhalation of VOCs from Ground Water	VOCs						
		1,2-DCE	7.6 E-04	NA	NA	NA	1 E-02	8 E-02
		TCE	7.6 E-05	3.3 E-05	6.0 E-03	2 E-07	2.9 -03	3 E-02
		vinyl chloride	1.6 E-03	6.7 E-04	3.0 E-01	2 E-04	NA	--
	PATHWAY TOTAL					2 E-04		1 E-01
	TOTAL FOR FUTURE OFF-POST RESIDENTS					3 E-03		3 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
Mowers	1. Soil Ingestion	VOCs						
		chloroform	NONE	NONE	6.1 E-03	NONE	1 E-02	NONE
		1,1-dichloroethane (1,1-	NONE	NONE	NA	NONE	1 E-01	NONE
		DCA)	1.2 E-07	NA	NA	NA	1 E-02	1 E-05
		cis-1,2-DCE	NONE	NA	NA	NA	1 E-01	NONE
		ethylbenzene	NONE	NA	NA	NA	6 E-01	NONE
		methylethyl ketone	NONE	NA	NA	NA	5 E-02	NONE
		(MEK)	1.1 E-07	NA	5.2 E-02	NA	1 E-02	1 E-05
		methyl isobutyl	3.2 E-07	NA	NA	NA	2 E-01	2 E-06
		ketone(MIBK)	NONE	NA	NA	NA	9 E-02	NONE
		PCE	5.4 E-07	1.9 E-07	1.1 E-02	2 E-09	1 E-01	5 E-06
		toluene	NONE	NA	NA	NA	2 E+00	NONE
		1,1,1-trichloroethane						
		TCE						
		xylenes (total)	8.5 E-07	3.0 E-07	1.4 E-02	4 E-09	2 E-02	4 E-05
		Base/Neutral and Acid	2.3 E-07	NA	NA	NA	1 E -01	2 E-06
		Extractable Compounds	2.3 E-07	NA	NA	NA	4 E-02	6 E-06
		bis(2-						
		ethylhexyl)phthalate	2.4 E-05	NA	NA	NA	7 E-02	3 E-04
		di-n-butyl phthalate	1.1 E-07	4.1 E-08	NA	--	1 E-03	2 E-04
		fluoranthene	6.4 E-06	2.3 E-06	NA	--	5 E-03	6 E-06
		Inorganics	2.1 E-04	NA	NA	NA	4 E-02	5 E-03
		barium	3.8 E-05	1.4 E-05	NA	--	NA	--
		cadmium	1.4 E-07	NA	NA	NA	3 E-04	5 E-04
		chromium	8.0 E-08	NA	NA	NA	5 E-03	2 E-05
		copper	9.4 E-05	NA	NA	NA	3 E-01	3 E-04
		lead						
		mercury						
		silver						
		zinc						
	PATHWAY TOTAL					6 E-09		7 E-03

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	2. Inhalation of Soil Particulates	VOCs						
		chloroform	NONE	NONE	8.1 E-025	NONE	NA	NONE
		1,1-DCA	NONE	NONE	NA	NONE	1.4 E-07	NONE
		cis-1,2-DCE	NONE	NA	NA	NA	NA	NONE
		ethybenzene	NONE	NA	NA	NA	1 E+00	NONE
		methylethyl ketone	NONE	NA	NA	NA	1 E+00	NONE
		(MEK)	NONE	NA	NA	NA	2.2 E-02	NONE
		MIBK	NONE	NA	2.0 E-03	NA	NA	NONE
		PCE	NONE	NA	NA	NA	4 E-01	NONE
		toluene	NONE	NA	NA	NA	NA	NONE
		1,1,1-trichloroethane	NONE	NONE	6.0 E-03	NONE	1 E-02	NONE
		TCE	NONE	NA	NA	NA	NA	NONE
		xylenes (total)						
		Base/Neutral and Acid Extractable Compounds	2.1 E-07	7.4 E-08	NA	1 E-09	NA	1 E-05
		bis(2-	5.5 E-08	NA	NA	NA	NA	5 E-07
		ethylhexyl)phthalate	5.5 E-08	NA	NA	NA	NA	1 E-06
		di-n-butyl phthalate						
		fluoranthene	6.0 E-06	NA	NA	NA	1.4 E-04	4 E-02
		Inorganics	2.8 E-08	9.9 E-09	6.1 E+00	6 E-08	NA	6 E-05
		barium	1.6 E-06	5.6 E-07	4.1 E+01	2 E-05	5.5 E-07	--
		cadmium	5.2 E-05	NA	NA	NA	NA	1 E-03
		chromium	9.2 E-06	3.3 E-06	NA	--	NA	--
		copper	3.5 E-08	NA	NA	NA	3 E-04	4 E-04
		lead	2.0 E-08	NA	NA	NA	NA	4 E-06
		mercury	2.3 E-05	NA	NA	NA	NA	8 E-05
		silver						
		zinc						
	PATHWAY TOTAL					2 E-05		4 E-02

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	3. Inhalation of VOCs from Soil	VOCs						
		chloroform	4.3 E-07	1.5 E-07	8.1 E-02	1 E-08	1 E-02	4 E-05
		1,1-DCA	3.4 E-08	1.2 E-08	NA	--	1.4 E-07	2 E-01
		cis-1,2-DCE	2.8 E-05	NA	NA	NA	1 E-02	3 E-03
		ethybenzene	5.6 E-06	NA	NA	NA	2.9 E-01	2 E-05
		MEK	1.3 E-06	NA	NA	NA	2.9 E-01	5 E-06
		MIBK	2.2 E-07	NA	NA	NA	2.2 E-02	1 E-05
		PCE	2.5 E-04	NA	2.0 E-03	NA	1 E-02	3 E-02
		toluene	1.3 E-04	NA	NA	NA	1.1 E-01	1 E-03
		1,1,1-trichloroethane	5.6 E-07	NA	NA	NA	9 E-02	6 E-06
		TCE	6.3 E-04	2.3 E-04	6.0 E-03	1 E-06	2.9 E-03	2 E-01
		xylenes (total)	2.4 E-05	NA	NA	NA	2 E+00	1 E-05
		Base/Neutral and Acid Extractables (BNAs)						
		bis(2-	NONE	NONE	NA	NONE	2 E-02	NONE
		ethylhexyl)phthalate	NONE	NA	NA	NA	1 E-01	NONE
		di-n-butyl phthalate	NONE	NA	NA	NA	4 E-02	NONE
		fluoranthene						
		Inorganics	NONE	NA	NA	NA	1.4 E-04	NONE
		barium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		cadmium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		chromium	NONE	NA	NA	NA	4 E-02	NONE
		copper	NONE	NONE	NA	NONE	NA	NONE
		lead	NONE	NA	NA	NA	8.5 E-05	NONE
		mercury	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	3 E-01	NONE
		zinc						
PATHWAY TOTAL						1 E-06		5 E-01
TOTAL FOR MOWERS						2 E-05		5 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
Future Construction Workers	1. Ingestion of Ground water	VOCs						
		carbon tetrachloride	1.0 E-07	7.2 E-09	1.3 E-01	9 E-10	7 E-03	1 E-05
		chloroform	3.3 E-08	2.3 E-09	6.1 E-03	1 E-11	1 E-02	3 E-06
		1,1-DCA	NONE	NONE	NA	NONE	1 E+00	NONE
		1,1-DCE	4.0 E-08	2.8 E-09	6.0 E-01	2 E-09	9 E-03	4 E-06
		1,2-DCE (cis and trans)	NONE	NA	NA	NA	1 E-01	NONE
		ethylbenzene	NONE	NA	NA	NA	1 E+00	NONE
		methylene chloride	NONE	NONE	7.5 E-03	NONE	6 E-02	NONE
		MEK	NONE	NA	NA	NA	5 E-01	NONE
		MIBK	NONE	NA	NA	NA	5 E-01	NONE
		PCE	NONE	NA	5.2 E-02	NA	1 E-01	NONE
		toluene	NONE	NA	NA	NA	2 E+00	NONE
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-01	NONE
		TCE	NONE	NONE	1.1 E-02	NONE	1 E-01	NONE
		vinyl chloride	8.7 E-08	6.2 E-09	1.9 E+00	1 E-08	NA	--
		xylenes		NA	NA	NA	4 E+00	NONE
		BNAs	NONE					
		bis(2-	1.8 E-07	NONE	1.4 E-02	NONE	2 E-02	NONE
		ethylhexyl)phthalate	NONE	1.3 E-08	2.9 E-02	4 E-10	NA	--
		chrysene	NONE	NA	NA	NA	1 E+00	NONE
		di-n-butyl phthalate	NONE	NA	NA	NA	4 E-01	NONE
		fluoranthene	NONE	NA	NA	NA	NA	NONE
		pheNAnthrene		NA	NA	NA	1 E -02	NONE
		1,2,4-trichlorobenzene	NONE					
		Explosives	NONE	NA	NA	NA	1 E -03	NONE
		1,3-dinitrobenzene	2.1 E-08	NONE	6.8 E-01	NONE	NA	NONE
		2,6-dinitrotoluene	NONE	1.5 E-09	1.1 E-01	2 E-10	3 E-03	7 E-06
		RDX	NONE	NA	NA	NA	5 E -04	NONE
		1,3,5-trinitrobenzene		NONE	3.0 E-02	NONE	5 E-04	NONE
		2,4,6-trinitrotoluene						

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	1. Ingestion of Ground water (Cont.)	Inorganics (dissolved)						
		antimony	7.7 E-07	NA	NA	NA	4 E-04	2 E-03
		arsenic	5.1 E-08	3.6 E-09	1.8 E+00	7 E-09	3 E-04	2 E-04
		barium	3.3 E-06	NA	NA	NA	7 E-02	5 E-05
		beryllium	NONE	NONE	4.3 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	NA	NONE	5 E-04	NONE
		chromium	NONE	NONE	NA	NONE	2 E-02	NONE
		copper	9.7 E-08	NA	NA	NA	4 E-02	2 E-06
		lead	4.4 E-08	3.1 E-09	NA	--	NA	--
		mercury	NONE	NA	NA	NA	3 E-04	NONE
		nickel	2.1 E-07	NA	NA	NA	2 E-02	1 E-05
		selenium	4.3 E-08	NA	NA	NA	5 E-03	9 E-06
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	3.4 E-06	NA	NA	NA	2 E-01	2 E-05
		Inorganics (total)						
		arsenic	1.9 E-07	1.3 E-08	1.8 E+00	2 E-08	3 E -04	6 E-04
		barium	6.8 E-06	NA	NA	NA	7 E-02	1 E-04
		beryllium	1.2 E-08	8.5 E-10	4.3 E+00	4 E-09	5 E-03	2 E-06
		cadmium	5.8 E-08	4.2 E-09	NA	--	5 E-04	1 E-04
		chromium	3.8 E-07	2.7 E-08	NA	--	2 E-02	4 E-07
		copper	3.8 E-07	NA	NA	NA	4 E-02	1 E-05
		lead	158 E-07	1.1 E-08	NA	--	NA	--
		mercury	NONE	NA	NA	NA	3 E-04	NONE
		nickel	4.5 E-07	NA	NA	NA	2 E-02	2 E-05
		selenium	3.4 E-08	NA	NA	NA	5 E-03	7 E-06
		silver	6.9 E-08	NA	NA	NA	5 E-03	1 E-05
		zinc	4.6 E-06	NA	NA	NA	2 E-01	2 E-05
PATHWAY TOTAL (using dissolved metals conc.)						2 E-08		2 E-03
PATHWAY TOTAL (using total metals conc.)						4 E-08		9 E-04

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	2. Ingestion of Soil	VOCs						
		carbon tetrachloride	NONE	NONE	1.3 E-01	NONE	7 E-03	NONE
		chloroform	4.5 E-10	3.2 E-11	6.1 E-03	2 E-13	1 E-02	5 E-08
		1,1-DCA	NONE	NONE	NA	NONE	1 E+00	NONE
		1,1-DCE	NONE	NONE	6.0 E-01	NONE	9 E-03	NONE
		1,2-DCE (cis and trans)	8.5 E-06	NA	NA	NA	1 E-01	9 E-05
		ethylbenzene	2.9 E-06	NA	NA	NA	1 E+00	3 E-06
		methylene chloride	1.6 E-06	1.1 E-07	7.5 E-03	9 E-10	6 E-02	3 E-05
		MEK	NONE	NA	NA	NA	5 E-01	NONE
		MIBK	NONE	NA	NA	NA	5 E-01	NONE
		PCE	1.3 E-05	NA	5.2 E-02	NA	1 E-01	1 E-04
		toluene	2.3 E-05	NA	NA	NA	2 E+00	1 E-05
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-01	NONE
		TCE	9.7 E-05	6.9 E-06	1.1 E-02	8 E-08	1 E-01	1 E-03
		vinyl chloride	1.1 E-07	7.9 E-09	1.9 E+00	2 E-08	NA	NONE
		xylenes	NONE	NA	NA	NA	4 E+00	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	2.4 E-06	1.7 E-07	1.4 E-02	2 E-09	2 E-02	NONE
		chrysene	NONE	NONE	2.9 E-02	NONE	NA	--
		di-n-butyl phthalate	5.6 E-07	NA	NA	NA	1 E+00	NONE
		fluoranthene	4.0 E-07	NA	NA	NA	4 E-01	NONE
		pheNAnthrene	4.2 E-07	NA	NA	NA	NA	NONE
		1,2,4-trichlorobenzene	1.4 E-06	NA	NA	NA	1 E -02	NONE
		Explosives	5.6 E-08	NA	NA	NA	1 E -03	6 E-05
		1,3-dinitrobenzene	1.0 E-07	7.2 E-09	6.8 E-01	5 E-09	NA	5 E-05
		2,6-dinitrotoluene	5.8 E-07	4.1 E-08	1.1 E-01	5 E-09	3 E-03	2 E-04
		RDX	1.1 E-06	NA	NA	NA	5 E -04	2 E-03
		1,3,5-trinitrobenzene	1.0 E-07	7.2 E-09	3.0 E-02	2 E-10	5 E-04	2 E-04
		2,4,6-trinitrotoluene						

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	2. Ingestion of Soil (Cont.)	Inorganics (dissolved)						
		antimony	NONE	NA	NA	NA	4 E-04	NONE
		arsenic	8.3 E-07	5.9 E-08	1.8 E+00	1 E-07	3 E-04	3 E-03
		barium	5.0 E-05	NA	NA	NA	7 E-02	7 E-04
		beryllium	9.6 E-07	6.8 E-08	4.3 E+00	3 E-07	5 E-03	2 E-04
		cadmium	1.8 E-07	1.3 E-08	NA	--	5 E-04	4 E-04
		chromium	1.2 E-05	8.3 E-07	NA	--	2 E-02	1 E-05
		copper	2.2 E-04	NA	NA	NA	4 E-02	5 E-03
		lead	5.3 E-05	3.8 E-06	NA	--	NA	--
		mercury	1.6 E-07	NA	NA	NA	3 E-04	5 E-04
		nickel	4.3 E-06	NA	NA	NA	2 E-02	2 E-04
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	1.3 E-07	NA	NA	NA	5 E-03	3 E-05
		zinc	1.3 E-04	NA	NA	NA	2 E-01	6 E-04
		Inorganics (total)						
		arsenic	8.3 E-07	5.9 E-08	1.8 E+00	1 E-07	3 E-04	3 E-03
		barium	5.0 E-05	NA	NA	NA	7 E-02	7 E-04
		beryllium	9.6 E-07	6.8 E-10	4.3 E+00	4 E-09	5 E-03	2 E-04
		cadmium	1.8 E-07	1.3 E-08	NA	--	5 E-04	4 E-04
		chromium	1.2 E-05	8.3 E-07	NA	--	2 E-02	1 E-05
		copper	2.2 E-04	NA	NA	NA	4 E-02	5 E-03
		lead	5.3 E-05	3.8 E-06	NA	--	NA	--
		mercury	1.6 E-07	NA	NA	NA	3 E-04	5 E-04
		nickel	4.3 E-06	NA	NA	NA	2 E-02	2 E-04
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	1.3 E-07	NA	NA	NA	5 E-03	3 E-05
		zinc	1.3 E-04	NA	NA	NA	2 E-01	6 E-04
PATHWAY TOTAL (using dissolved metals)						5 E-07		2 E-02
PATHWAY TOTAL (using total metals)						5 E-07		2 E-02

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	3. Dermal Contact with Ground Water	VOCs						
		carbon tetrachloride	7.3 E-07	5.2 E-08	NA	7 E-09	NA	1 E-04
		chloroform	8.9 E-08	6.4 E-09	NA	4 E-11	NA	9 E-06
		1,1-DCA	NONE	NONE	NA	NONE	NA	NONE
		1,1-DCE	1.9 E-07	1.3 E-08	NA	8 E-09	NA	2 E-05
		1,2-DCE (cis and trans)	NONE	NA	NA	NA	NA	NONE
		ethylbenzene	NONE	NA	NA	NA	NA	NONE
		methylene chloride	NONE	NONE	NA	NONE	NA	NONE
		MEK	NONE	NA	NA	NA	NA	NONE
		MIBK	NONE	NA	NA	NA	NA	NONE
		PCE	NONE	NA	NA	NA	NA	NONE
		toluene	NONE	NA	NA	NA	NA	NONE
		1,1,1-trichloroethane	NONE	NA	NA	NA	NA	NONE
		TCE	NONE	NONE	NA	NONE	NA	NONE
		vinyl chloride	1.8 E-07	1.3 E-08	NA	2 E-08	NA	--
		xylenes	NONE	NA	NA	NA	NA	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	NONE	NONE	NA	NONE	NA	NONE
		chrysene	7.0 E-05	5.0 E-06	NA	1 E-07	NA	--
		di-n-butyl phthalate	NONE	NA	NA	NA	NA	NONE
		fluoranthene	NONE	NA	NA	NA	NA	NONE
		pheNAnthrene	NONE	NA	NA	NA	NA	NONE
		1,2,4-trichlorobenzene						
		Explosives	NONE	NA	NA	NA	NA	NONE
		1,3-dinitrobenzene	NONE	NONE	NA	NONE	NA	NONE
		2,6-dinitrotoluene	---	---	NA	--	NA	--
		RDX	NONE	NA	NA	NA	NA	NONE
		1,3,5-trinitrobenzene	NONE	NONE	NA	NONE	NA	NONE
		2,4,6-trinitrotoluene						

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
	3. Dermal Contact with Ground Water (Cont.)	Inorganics (dissolved)						
		antimony	2.0 E-07	NA	NA	NA	4 E-04	5 E-03
		arsenic	1.3 E-08	9.4 E-10	1.8 E+00	2 E-09	3 E-04	5 E-05
		barium	8.7 E-07	NA	NA	NA	7 E-02	1 E-04
		beryllium	NONE	NONE	4.3 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	NA	NONE	5 E-04	NONE
		chromium	NONE	NONE	NA	NONE	2 E-02	NONE
		copper	2.5 E-08	NA	NA	NA	4 E-02	1 E-06
		lead	4.5 E-11	3.2 E-12	NA	--	NA	--
		mercury	NONE	NA	NA	NA	3 E-04	NONE
		nickel	5.3 E-09	NA	NA	NA	2 E-02	3 E-06
		selenium	1.1 E-08	NA	NA	NA	5 E-03	2 E-05
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	5.4 E-07	NA	NA	NA	2 E-01	3 E-06
		Inorganics (total)						
		arsenic	4.9 E-08	9.4 E-10	1.8 E+00	7 E-09	3 E-04	2 E-04
		barium	1.8 E-06	NA	NA	NA	7 E-02	3 E-04
		beryllium	3.1 E-09	NONE	4.3 E+00	9 E-09	5 E-03	6 E-06
		cadmium	1.5 E-08	NONE	NA	--	5 E-04	3 E-04
		chromium	2.0 E-07	NONE	NA	--	2 E-02	5 E-05
		copper	1.0 E-07	NA	NA	NA	4 E-02	4 E-06
		lead	1.6 E-10	3.2 E-12	NA	--	NA	--
		mercury	NONE	NA	NA	NA	3 E-04	NONE
		nickel	1.2 E-08	NA	NA	NA	2 E-02	6 E-06
		selenium	8.8 E-09	NA	NA	NA	5 E-03	2 E-05
		silver	1.1 E-08	NA	NA	NA	5 E-03	2 E-05
		zinc	7.2 E-07	NA	NA	NA	2 E-01	5 E-06
PATHWAY TOTAL (using dissolved metals)						2 E-07		5 E-03
PATHWAY TOTAL (using total metals)						2 E-07		1 E-03

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	4. Inhalation of VOCs from Water	VOCs						
		carbon tetrachloride	4.0 E-04	2.9 E-05	5.3 E-02	2 E-06	7 E-03	6 E-02
		chloroform	1.5 E-04	1.1 E-05	8.1E-02	9 E-07	1 E-02	1 E-02
		1,1-DCA	NONE	NONE	NA	NONE	1.4 E-07	NONE
		1,1-DCE	2.0 E-04	1.4 E-05	1.2 E+00	2 E-05	9 E-03	2 E-02
		1,2-DCE (cis and trans)	NONE	NA	NA	NA	1 E-01	NONE
		ethylbenzene	NONE	NA	NA	NA	2 E-01	NONE
		methylene chloride	NONE	NONE	1.6 E-03	NONE	8.6 E-01	NONE
		MEK	NONE	NA	NA	NA	2.9 E-01	NONE
		MIBK	NONE	NA	NA	NA	2.2 e -01	NONE
		PCE	NONE	NA	2.0 E-03	NA	1 E-01	NONE
		toluene	NONE	NA	NA	NA	5.7 E-01	NONE
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-01	NONE
		TCE	NONE	NONE	6.0 E-03	NONE	2.9 E-02	NONE
		vinyl chloride	5.5 E-04	3.9 E-05	3.0 E-01	1 E-05	NA	--
		xylenes	NONE	NA	NA	NA	4 E+00	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	NONE	NONE	NA	NONE	2 E-02	NONE
		chrysene	2.4 E-05	1.7 E-06	2.4 E-02	4 E-08	NA	--
		di-n-butyl phthalate	NONE	NA	NA	NA	1 E+00	NONE
		fluoranthene	NONE	NA	NA	NA	4 E-01	NONE
		pheNAnthrene	NONE	NA	NA	NA	NA	NONE
		1,2,4-trichlorobenzene	NONE	NA	NA	NA	2.5 E-03	NONE
		Explosives						
		1,3-dinitrobenzene	NONE	NONE	NA	NONE	1 E-03	NONE
		2,6-dinitrotoluene	---	---	NA	--	NA	NONE
		RDX	NONE	NA	NA	NA	3 E-03	NONE
		1,3,5-trinitrobenzene	NONE	NONE	NA	NONE	5 E-04	NONE
		2,4,6-trinitrotoluene					5 E-04	NONE

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
	4. Inhalation of VOCs from Water (Cont.)	Inorganics (dissolved)						
		antimony	NONE	NA	NA	NA	4 E-04	NONE
		arsenic	NONE	NONE	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NA	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		chromium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		copper	NONE	NA	NA	NA	4 E-02	NONE
		lead	NONE	NONE	NA	NONE	NA	NONE
		mercury	NONE	NA	NA	NA	8.6 E-05	NONE
		nickel	NONE	NA	NA	NA	2 E-02	NONE
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	NONE	NA	NA	NA	2 E-01	NONE
		Inorganics (total)						
		arsenic	NONE	NONE	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NA	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		chromium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		copper	NONE	NA	NA	NA	4 E-02	NONE
		lead	NONE	NONE	NA	NONE	NA	NONE
		mercury	NONE	NA	NA	NA	8.6 E-05	NONE
		nickel	NONE	NA	NA	NA	2 E-02	NONE
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	NONE	NA	NA	NA	2 E-01	NONE
PATHWAY TOTAL (using dissolved metals)						3 E-05		9 E-02
PATHWAY TOTAL (using total metals)						3 E-05		9 E-02

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	5. Inhalation of Soil Particulates	VOCs						
		carbon tetrachloride	NONE	NONE	5.3 E-02	NONE	7 E-03	NONE
		chloroform	NONE	NONE	8.1E-02	NONE	1 E-02	NONE
		1,1-DCA	NONE	NONE	NA	NONE	1.4 E-07	NONE
		1,1-DCE	NONE	NONE	1.2 E+00	NONE	9 E-03	NONE
		1,2-DCE (cis and trans)	NONE	NA	NA	NA	1 E-01	NONE
		ethylbenzene	NONE	NA	NA	NA	2 E-01	NONE
		methylene chloride	NONE	NONE	1.6 E-03	NONE	8.6 E-01	NONE
		MEK	NONE	NA	NA	NA	2.9 E-01	NONE
		MIBK	NONE	NA	NA	NA	2.2 e -01	NONE
		PCE	NONE	NA	2.0 E-03	NA	1 E-01	NONE
		toluene	NONE	NA	NA	NA	5.7 E-01	NONE
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-01	NONE
		TCE	NONE	NONE	6.0 E-03	NONE	2.9 E-02	NONE
		vinyl chloride	NONE	NONE	3.0 E-01	NONE	NA	NONE
		xylenes	NONE	NA	NA	NA	4 E+00	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	5.4 E-06	3.8 E-07	NA	5 E-09	2 E-02	3 E-04
		chrysene	NONE	NONE	2.4 E-02	NONE	NA	NONE
		di-n-butyl phthalate	1.3 E-06	NA	NA	NA	1 E+00	1 E-06
		fluoranthene	9.0 E-07	NA	NA	NA	4 E-01	2 E-06
		pheNAnthrene	9.5 E-07	NA	NA	NA	NA	--
		1,2,4-trichlorobenzene	3.1 E-06	NA	NA	NA	2.5 E-03	1 E-03
		Explosives	1.3 E-07	NA	NA	NA	1 E-03	1 E-04
		1,3-dinitrobenzene	2.3 E-07	1.6 E-08	NA	1 E-08	NA	1 E-04
		2,6-dinitrotoluene	1.3 E-06	9.3 E-08	NA	1 E-08	3 E-03	4 E-04
		RDX	2.6 E-07	NA	NA	NA	5 E-04	5 E-03
		1,3,5-trinitrobenzene	2.3 E-07	1.6 E-08	NA	5 E-10	5 E-04	5 E-04
		2,4,6-trinitrotoluene						

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
	5. Inhalation of Soil Particulates (Cont.)	Inorganics (dissolved)						
		antimony	NONE	NA	NA	NA	4 E-04	NONE
		arsenic	1.9 E-06	1.3 E-07	5.0 E+01	7 E-06	3 E-04	6 E-03
		barium	1.1 E-04	NA	NA	NA	1.4 E-04	8 E-01
		beryllium	2.2 E-06	1.5 E-07	8.4 E+00	1 E-06	5 E-03	4 E-04
		cadmium	4.0 E-07	2.9 E-08	6.1 E+00	2 E-07	5 E-04	8 E-04
		chromium	2.6 E-05	1.9 E-06	4.1 E+01	8 E-05	5.5 E-07	--
		copper	4.8 E-04	NA	NA	NA	4 E-02	1 E-02
		lead	1.2 E-04	8.5 E-06	NA	--	NA	--
		mercury	3.7 E-07	NA	NA	NA	8.6 E-05	4 E-03
		nickel	9.6 E-06	NA	NA	NA	2 E-02	5 E-04
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	2.8 E-07	NA	NA	NA	5 E-03	6 E-05
		zinc	2.8 E-04	NA	NA	NA	2 E-01	1 E-03
		Inorganics (total)						
		arsenic	1.9 E-06	1.3 E-07	5.0 E+01	7 E-06	3 E-04	6 E-03
		barium	1.1 E-04	NA	NA	NA	1.4 E-04	8 E-01
		beryllium	2.2 E-06	1.5 E-07	8.4 E+00	1 E-06	5 E-03	4 E-04
		cadmium	4.0 E-076	2.9 E-08	6.1 E+00	2 E-07	5 E-04	8 E-04
		chromium	2.6 E-05	1.9 E-06	4.1 E+01	8 E-05	5.5 E-07	--
		copper	4.8 E-04	NA	NA	NA	4 E-02	1 E-02
		lead	1.2 E-04	8.5 E-06	NA	--	NA	--
		mercury	3.7 E-07	NA	NA	NA	8.6 E-05	4 E-03
		nickel	9.6 E-06	NA	NA	NA	2 E-02	5 E-04
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	2.8 E-07	NA	NA	NA	5 E-03	6 E-05
		zinc	2.8 E-04	NA	NA	NA	2 E-01	1 E-03
PATHWAY TOTAL (using dissolved metals)						8 E-05		8 E-01
PATHWAY TOTAL (using total metals)						8 E-05		8 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	6. Inhalation of VOCs from Soil	VOCs						
		carbon tetrachloride	NONE	NONE	5.3 E-02	NONE	7 E-03	NONE
		chloroform	2.4 E-06	1.7 E-07	8.1E-02	1 E-08	1 E-02	2 E-04
		1,1-DCA	1.9 E-07	1.3 E-08	NA	--	1.4 E-07	1 E+00
		1,1-DCE	NONE	NONE	1.2 E+00	NONE	9 E-03	NONE
		1,2-DCE (cis and trans)	1.6 E-04	NA	NA	NONE	1 E-01	2 E-03
		ethylbenzene	3.1 E-05	NA	NA	NA	2 E-01	1 E-04
		methylene chloride	NONE	NONE	1.6 E-03	NONE	8.6 E-01	NONE
		MEK	7.2 E-06	NA	NA	NA	2.9 E-01	2 E-05
		MIBK	1.2 E-06	NA	NA	NA	2.2 e -01	5 E-05
		PCE	1.4 E-03	NA	2.0 E-03	NA	1 E-01	1 E-02
		toluene	7.2 E-04	NA	NA	NA	5.7 E-01	1 E-03
		1,1,1-trichloroethane	3.1 E-06	NA	NA	NA	9 E-01	3 E-06
		TCE	3.5 E-03	2.5 E-04	6.0 E-03	2 E-06	2.9 E-02	1 E-01
		vinyl chloride	NONE	NONE	3.0 E-01	NONE	NA	NONE
		xylenes	1.3 E-04	NA	NA	NA	4 E+00	3 E-05
		BNAs						
		bis(2-ethylhexyl)phthalate	NONE	NONE	NA	NONE	2 E-02	NONE
		chrysene	NONE	NONE	2.4 E-02	NONE	NA	NONE
		di-n-butyl phthalate	NONE	NA	NA	NONE	1 E+00	NONE
		fluoranthene	NONE	NA	NA	NONE	4 E-01	NONE
		pheNAnthrene	NONE	NA	NA	NONE	NA	NONE
		1,2,4-trichlorobenzene	NONE	NA	NA	NONE	2.5 E-03	NONE
		Explosives						
		1,3-dinitrobenzene	NONE	NONE	NA	NONE	1 E-03	NONE
		2,6-dinitrotoluene	NONE	NONE	NA	NONE	NA	NONE
		RDX	NONE	NA	NA	NONE	3 E-03	NONE
		1,3,5-trinitrobenzene	NONE	NA	NA	NONE	5 E-04	NONE
		2,4,6-trinitrotoluene	NONE	NONE	NA	NONE	5 E-04	NONE

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	6. Inhalation of VOCs from Soil (Cont.)	Inorganics (dissolved)						
		antimony	NONE	NA	NA	NA	4 E-04	NONE
		arsenic	NONE	NONE	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NA	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		chromium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		copper	NONE	NA	NA	NA	4 E-02	NONE
		lead	NONE	NONE	NA	NA	NA	NONE
		mercury	NONE	NA	NA	NA	8.6 E-05	NONE
		nickel	NONE	NA	NA	NA	2 E-02	NONE
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	NONE	NA	NA	NA	2 E-01	NONE
		Inorganics (total)						
		arsenic	NONE	NONE	5.0 E+01	NONE	3 E-04	NONE
		barium	NONE	NA	NA	NA	1.4 E-04	NONE
		beryllium	NONE	NONE	8.4 E+00	NONE	5 E-03	NONE
		cadmium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		chromium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		copper	NONE	NA	NA	NA	4 E-02	NONE
		lead	NONE	NONE	NA	NONE	NA	NONE
		mercury	NONE	NA	NA	NA	8.6 E-05	NONE
		nickel	NONE	NA	NA	NA	2 E-02	NONE
		selenium	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	5 E-03	NONE
		zinc	NONE	NA	NA	NA	2 E-01	NONE
PATHWAY TOTAL (using dissolved metals)						2 E-06		1 E+00
PATHWAY TOTAL (using total metals)						2 E-06		1 E+00

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
TOTAL FOR FUTURE CONSTRUCTION WORKERS (using dissolved metals)						1 E-04		2 E+00
TOTAL FOR FUTURE CONSTRUCTION WORKERS (using total metals)						1 E-04		2 E+00

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer SF (mg/kg-day)-1	Cancer Risk (CDI x SF)	Noncancer RfD (mg/kg-day)	Noncancer Hazard Index (CDI / RfD)
NAtioNAl Guardsmen	1. Ingestion of Soil	VOCs						
		chloroform	NONE	NONE	6.1 E-03	NONE	1 E-02	NONE
		1,1-DCA	NONE	NONE	NA	NONE	1 E-01	NONE
		cis-1,2-DCE	2.3 E-07	NA	NA	NA	1 E-02	2 E-05
		ethylbenzene	NONE	NA	NA	NA	1 E-01	NONE
		MEK	NONE	NA	NA	NA	6 E-01	NONE
		MIBK	NONE	NA	NA	NA	5 E-02	NONE
		PCE	2.3 E-07	NA	5.2 E-02	NA	1 E-02	2 E-05
		toluene	6.5 E-07	NA	NA	NA	2 E-01	3 E-06
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-02	NONE
		TCE	1.1 E-06	1.5 E-07	1.1 E-02	2 E-09	1 E-01	1 E-05
		xylenes (total)	NONE	NA	NA	NA	2 E+00	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	1.7 E-06	2.4 E-07	1.4 E-02	3 E-09	2 E-02	8 E-05
		di-n-butyl phthalate	4.5 E-07	NA	NA	NA	1 E-01	4 E-06
		fluoranthene	4.5 E-07	NA	NA	NA	4 E-02	1 E-05
		Inorganics						
		barium	4.9 E-05	NA	NA	NA	7 E-02	7 E-04
		cadmium	2.3 E-07	3.2 E-08	NA	--	1 E-03	5 E-04
		chromium	1.3 E-05	1.8 E-06	NA	--	5 E-03	1 E-05
		copper	4.3 E-04	NA	NA	NA	4 E-02	1 E-02
		lead	7.5 E-05	1.1 E-05	NA	--	NA	--
		mercury	2.8 E-07	NA	NA	NA	3 E-04	9 E-04
		silver	1.6 E-07	NA	NA	NA	5 E-03	3 E-05
		zinc	1.9 E-04	NA	NA	NA	3 E-01	6 E-04
	PATHWAY TOTAL					5 E-09		1 E-02

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	2. Inhalation of Soil Particulates	VOCs						
		chloroform	NONE	NONE	8.1 E-02	NONE	1 E-02	NONE
		1,1-DCA	NONE	NONE	NA	NONE	1.4 E-07	NONE
		cis-1,2-DCE	NONE	NA	NA	NA	1 E-02	NONE
		ethylbenzene	NONE	NA	NA	NA	2.9 E-01	NONE
		MEK	NONE	NA	NA	NA	2.9 E-01	NONE
		MIBK	NONE	NA	NA	NA	2.2 E-02	NONE
		PCE	NONE	NA	2.0 E-03	NA	1 E-02	NONE
		toluene	NONE	NA	NA	NA	1.1 E-01	NONE
		1,1,1-trichloroethane	NONE	NA	NA	NA	9 E-02	NONE
		TCE	NONE	NONE	6.0 E-3	NONE	2.9 E-03	NONE
		xylenes (total)	NONE	NA	NA	NA	2 E+00	NONE
		BNAs						
		bis(2-ethylhexyl)phthalate	7.5 E-07	1.1 E-07	NA	2 E-09	2 E-02	4 E-05
		di-n-butyl phthalate	2.0 E-07	NA	NA	NA	1 E-01	2 E-06
		fluoranthene	2.0 E-07	NA	NA	NA	4 E-02	5 E-06
		Inorganics						
		barium	2.2 E-05	NA	NA	NA	1.4 E-04	2 E-01
		cadmium	1.0 E-07	1.4 E-08	6.1 E+00	9 E-08	5 E-04	2 E-04
		chromium	5.7 E-06	8.1 E-07	4.1 E+01	3 E-05	5.5 E-07	--
		copper	1.9 E-04	NA	NA	NA	4 E-02	5 E-03
		lead	3.4 E-05	4.8 E-06	NA	--	NA	--
		mercury	1.3 E-07	NA	NA	NA	8.6 E-05	1 E-03
		silver	7.2 E-08	NA	NA	NA	5 E-03	1 E-05
		zinc	8.4 E-05	NA	NA	NA	3 E-01	3 E-04
	PATHWAY TOTAL					3 E-05		2 E-01

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
	3. Inhalation of VOCs from Soil	VOCs						
		chloroform	1.4 E-06	2.1 E-07	8.1 E-02	2 E-08	1 E-02	1 E-04
		1,1-DCA	1.1 E-07	1.6 E-08	NA	--	1.4 E-07	8 E-01
		cis-1,2-DCE	9.4 E-05	NA	NA	NA	1 E-02	9 E-03
		ethylbenzene	1.9 E-05	NA	NA	NA	2.9 E-01	6 E-05
		MEK	4.4 E-06	NA	NA	NA	2.9 E-01	2 E-05
		MIBK	7.2 E-07	NA	NA	NA	2.2 E-02	3 E-05
		PCE	8.3 E-04	NA	2.0 E-03	NA	1 E-02	8 E-02
		toluene	4.3 E-04	NA	NA	NA	1.1 E-01	4 E-04
		1,1,1-trichloroethane	1.9 E-06	NA	NA	NA	9 E-02	2 E-05
		TCE	2.1 E-03	3.0 E-04	6.0 E-3	2 E-06	2.9 E-03	2 E-02
		xylenes (total)	7.8 E-05	NA	NA	NA	2 E+00	4 E-05
		BNAs						
		bis(2-ethylhexyl)phthalate	NONE	NONE	NA	NONE	2 E-02	NONE
		di-n-butyl phthalate	NONE	NA	NA	NA	1 E-01	NONE
		fluoranthene	NONE	NA	NA	NA	4 E-02	NONE
		Inorganics	NONE	NA	NA	NA	1.4 E-04	NONE
		barium	NONE	NONE	6.1 E+00	NONE	5 E-04	NONE
		cadmium	NONE	NONE	4.1 E+01	NONE	5.5 E-07	NONE
		chromium	NONE	NA	NA	NA	4 E-02	NONE
		copper	NONE	NONE	NA	NONE	NA	NONE
		lead	NONE	NA	NA	NA	8.6 E-05	NONE
		mercury	NONE	NA	NA	NA	5 E-03	NONE
		silver	NONE	NA	NA	NA	3 E-01	NONE
		zinc						
PATHWAY TOTAL						2 E-06		2 E+00
TOTAL FOR NATIONAL GUARDSMEN						4 E-05		2 E+00

TABLE 4 (CONTINUED)

Total Exposure Point	Exposure Pathway	Chemicals of Potential Concern	Noncancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer Chronic Daily Intake (CDI) (mg/kg-day)	Cancer		Noncancer	
					SF (mg/kg-day)-1	Risk (CDI x SF)	RfD (mg/kg-day)	Hazard Index (CDI / RfD)
Meat Eaters	1. Ingestion of Meat	VOCs						
		cis-1,2-DCE	2.6 E-08	NA	NA	NA	1 E-02	3 E-06
		PCE	1.5 E-07	NA	5.2 E-02	NA	1 E-02	2 E-05
		toluene	9.1 E-08	NA	NA	NA	2 E-01	5 E-07
		TCE	6.4 E-08	2.7 E-08	1.1 E-02	3 E-10	1 E-01	6 E-07
		BNAs						
		bis(2-ethylhexyl)phthalate	2.3 E-06	9.9 E-07	1.4 E-02	1 E-08	2 E-02	1 E-04
		di-n-butyl phthalate	1.5 E-05	NA	NA	NA	1 E-01	1 E-04
		fluoranthene	3.3 E-06	NA	NA	NA	4 E-02	8 E-05
		Inorganics						
		barium	2.3 E-05	NA	NA	NA	7 E-02	3 E-04
		cadmium	1.6 E-06	7.0 E-07	NA	--	1 E-03	3 E-03
		chromium	2.2 E-04	9.3 E-05	NA	--	5 E-03	2 E-04
		copper	1.3 E-02	NA	NA	NA	4 E-02	3 E-01
		lead	7.0 E-05	3.0 E-05	NA	--	NA	--
		mercury	1.1 E-03	NA	NA	NA	3 E-04	4 E+00
		silver	6.4 E-06	NA	NA	NA	2 E-02	1 E-03
		zinc	5.9 E-02	NA	NA	NA	3 E-01	2 E-01
	PATHWAY TOTAL					1 E-08		4 E+00
	TOTAL FOR MEAT EATERS					1 E-08		4 E+00

NOTES:

(a) Based on the Area 18 RI.

(b) Chemicals of potential concern (COPCs) include chemicals that were carried through the risk analysis. COPCs may or may not become COCs as their concentrations, potential exposure scenarios, etc. are analyzed during the human health risk assessment.

(c) Based on an average of residential wells that were determined to be in the flow path of Area 18 ground water.

(d) Based only on the well resulting in maximum risk (Well C) to Lake City residents. This was done to address concerns that combined observations of all wells did no assess the maximum potential risk to Lake City residents. Refer to the Area 18 RI for detailed discussion regarding this topic.

APPENDIX D

APPLICABLE
OR
RELEVANT AND APPROPRIATE REQUIREMENTS

Action-Specific ARARs

DESCRIPTION OF REMEDIAL ALTERNATIVES AND SUMMARY OF ACTION-SPECIFIC ARARs

REMEDIAL ALTERNATIVE DESCRIPTION	ACTION-SPECIFIC ARARs	ARAR STATUS	COMMENTS
GROUND WATER ALTERNATIVES			
Alternative GW- 1: No Action	NA	NA	
Alternative GW-2: Ground Water Monitoring and Point-of-Use Treatment • Continued operation of onsite air stripping tower			Ground water ARARs are described under the discussion of Alternatives GW-3/GW-4 below. ARARs related to discharge of treated ground water are discussed under the various discharge items listed under Alternatives GW-3/GW-4.
• Continued discharge of treated water to onsite water treatment plant	42 USC 300(f)		Safe Drinking Water Act (SDWA) and State Drinking Water Regulations
• Ground water monitoring for the next 30 years • Deed restrictions for ground water usage	40 CFR § 141 10 CSR 60	Relevant and Appropriate	ARARs are the same as discussed under Alternatives GW-3/GW-4.
• Treatment of contaminated ground water before use by offsite users	33 USC 1251-1376		Clean Water Act (CWA) and State Surface Water Quality Regulations
	40 CFR § 403.5	Applicable	ARARs for discharge of treated ground water are the same as discussed under Alternatives GW-3/GW-4, Option #1.
	40 CFR § 264 Subpart X	Relevant and Appropriate	The thermal oxidation unit used to treat the collected vapors is a miscellaneous treatment unit under RCRA. ARARs are the same as described under Alternatives GW-3/GW-4

Alternative GW-2 (Continued)	42 U S C. 7401-7642		Clean Air Act (CAA)
	40 CFR § 50 10 CSR 10-6 010 10 CSR 10-6 060	Applicable	The operation of the Area 18 air stripper is subject to the air pollution control standards of the Clean Air Act as described under Alternatives GW-3/GW-4
	40 CFR § 61 10 CSR 10-6 080	Relevant and Appropriate	
	40 CFR § 261 40 CFR § 268	Applicable	40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. If the residuals from the treatment unit are determined to be hazardous waste and will be disposed of onsite, the LDRs will be applicable. LDRs require that RCRA hazardous wastes be treated to protective levels specified in 40 CFR 268 prior to land disposal

Alternative GW-3/GW-4: Extraction Wells/Air Stripping/Catalytic Oxidation/Discharge to POTW • Installation of ground water extraction wells and associated piping • Installation of air stripping tower • Provide process piping for discharge to POTW • Ground water monitoring	42 USC 300(g)		Safe Drinking Water Act (SDWA)
	40 CFR § 141 10 CSR 60	Relevant and Appropriate	40 CFR 141 establishes MCLs for specific contaminants in public drinking water. 40 CFR 141 also provides MCLGs which are set at levels of unknown or anticipated adverse health effects with and adequate margin of safety. MCLs and MCLGs are generally applicable under SDWA to the quality of drinking water at the point of distribution for consumption. They are considered relevant and appropriate to groundwater that may be used for drinking. 10 CSR 60 requires that all ground water used for drinking water is to be treated to drinking water standards. The Lake City aquifer is a drinking water aquifer and is used by LCAAP as a water supply.
	33 USC 1251-1376		Clean Water Act (CWA) CWA requirements are discussed under the discharge options listed below
	10 CSR 23-4.030 10 CSR 23-4.060 10 CSR 23-4.070	Applicable	As a part of this remedial alternative, extraction wells will be constructed. The substantive requirements of the Rules of the Missouri Department of Natural Resources, Division of Geology and Land Survey, Chapters 1 through 6 apply to all wells at LCAAP. Extraction wells used in site remediation are regulated by Chapter 4, titled "Monitoring Well Construction Code," and are included in the definition of "monitoring wells." Among other things, the Chapter 4 rules set forth criteria for the general protection of groundwater quality and resources. Criteria for the placement of wells is specified in 10 CSR 23-4.030. 10 CSR 23-4.060 specifies construction standards. However, according to 10 CSR 23-4.060, the standards for construction of extraction wells is determined on a case-by-case basis by the division. These details will be provided in the RD/RA workplan subject to review according to FFA provisions.

Alternative GW-3/GW-4 (Continued)	40 CFR § 264, Subpart X	Applicable	The thermal oxidation unit used to treat the collected vapors is classified as a miscellaneous treatment unit under RCRA and 40 CFR Part 264. 10 CSR 25-7.264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, is the state rule that corresponds to 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities. The State of Missouri does not have any provisions pertaining to miscellaneous treatment units. 40 CFR 264, Subpart X sets forth design, operational, and monitoring requirements for miscellaneous treatment units to ensure operations are protective of human health and the environment. It also references requirements of 40 CFR 264 Subparts I through O and AA through CC. The design, operating, and monitoring parameters of the treatment unit will be specified in the RD/RA workplan which is subject to approval according to EPA provisions.
	42 U.S.C. 7401-7642		Clean Air Act (CAA)
	40 CFR § 50 10 CSR 10-6.010 10 CSR 10-6.060	Applicable	The operation of the Area 18 air stripper is subject to the air pollution control standards of the Clean Air Act. The release of off-gas by the Area 18 air stripping unit is introduced to a catalytic oxidation unit which destroys VOCs imparted to the vapor phase. The emission from the catalytic oxidation unit will meet the applicable federal and state criteria under the standards of the Clean Air Act. 40 CFR 50 specifies Ambient Air Quality Standards for sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, particulate matter, and lead that are protective of public health. 10 CSR-6.010, Ambient Air Quality Standards, has the same requirements as 40 CFR 50 and adds ambient air quality standards for hydrogen sulfide and sulfuric acid. 40 CFR 61 establishes emissions standards for benzene, beryllium, mercury, and vinyl chloride. 10 CSR 10-6.080 adopts the requirements of 40 CFR 61 for these constituents. Benzene, beryllium, mercury, and vinyl chloride may be present at Area 18. 10 CSR 10-6.060 establishes ***de minimus*** levels for ozone emissions of 40 tons per year and vinyl chloride emissions of 1 ton per year.
	40 CFR § 61 10 CSR 10-6.080	Relevant and Appropriate	

Alternative GW-3/GW-4 (Continued)	40 CFR § 264 1032	Applicable	The operation of the Area 18 air stripper is subject to the requirements of 40 CFR 264 1032, which requires that the total organic emissions from all process vents be reduced to below 3 1 tons per year or be reduced by 95 percent by weight The federal standard is more stringent than the Missouri standard for emission limits under 10 CSR 10-6 100; therefore, the federal standard for operation of the air stripper would be applicable
	40 CFR § 261 40 CFR § 268	Applicable	For the Area 18 remediation, ARARs under RCRA relate to disposal of waste materials excavated from the site during construction and implementation of the remedial alternative, where the waste materials exhibit hazardous characteristics (i e , the TCLP test exceeds regulatory levels). 40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. Chemicals found in the soil at Area 18 and the corresponding regulatory limits for the toxicity characteristic are: mercury (0 2 mg/L); lead (5 0 mg/L), PCE (0 7 mg/L); TCE (0.5 mg/L); total cresol (200 mg/L), vinyl chloride (0 2 mg/L), benzene (0 5 mg/L), and 1,1 DCE (0 7 mg/L) Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. If it is and the hazardous soil is disposed of onsite, LDRs (40 CFR 268) would be applicable. If determined to be hazardous, contaminated media generated during construction of the Area 18 remedy will be subject to applicable provisions of RCRA for disposal as a hazardous waste. Also, sediments and/or sludge removed from the Area 18 treatment system during operation and spent catalyst from the catalytic oxidation unit will have to be disposed of according to 40 CFR 268 if they exhibit hazardous characteristics.

APPENDIX C

GROUND WATER TREATMENT DISCHARGE CRITERIA

Permit No. LB-0200-LC504

PART 1 - Effluent Limitations Continued:

J. During the period of February 21, 1997 to February 20, 2000 wastes containing any of the following substances in solution or in suspension in concentrations exceeding the maximum permissible concentration shall not be discharged through Outfall 003 to the District's system. Repeated or willful violation of these maximum limits shall be deemed sufficient to warrant enforcement action.

Parameter	Daily Maximum mg/l
pH	5 to 10.5 SI
1,1-Dichloroethane	0.026
1,1-Dichloroethene	0.035
1,2-Dichloroethene	0.400
1,1,1-Trichloroethane	0.900
Benzene	0.043
Carbon Tetrachloride	0.044
Chloroform	0.009
Ethyl Benzene	0.007
Methylene Chloride	0.030
Methylisobutyl Ketone	0.002
Toluene	0.110
Trichloroethene	0.680
Vinyl Chloride	0.250
Bis(2-Ethylhexyl)Phthalate	0.360
Chrysene	0.066
Di-N-Octyl Phthalate	0.013
2,4-Dinitrotoluene	0.006
HMX	0.002
Nitrobenzene	0.013
RDX	0.005
Antimony	0.078
Arsenic	0.030
Barium	0.856
Beryllium	0.010
Cadmium	0.200
Chromium	1.000
Copper	3.000
Lead	1.500
Nickel	1.000
Selenium	0.034
Silver	0.100
Zinc	5.000

TABLE 7 SUMMARY OF NONCARCINOGENIC RISKS (HIs) FROM FUTURE EXPOSURE SCENARIOS

Exposure Routes/Media	Exposure Groups		
	Future Off-Post Residents (Dissolved Metals)	Future Commercial/Industrial Workers (Dissolved Metals)	Future Commercial/Industrial Workers (Total Metals)
Duration of Exposure	Chronic	Chronic	Chronic
Ingestion of Ground Water	$1 \times 10^{+1}$	2×10^{0}	7×10^{0}
Ingestion of Soil		6×10^{-2}	6×10^{-2}
Dermal Contact With Ground Water	9×10^{-1}		
Dermal Contact With Soil		1×10^{-1}	1×10^{-1}
Inhalation of VOCs From Ground Water	2×10^{-3}		
Inhalation of Particulates from Soil		$5 \times 10^{+1(b)}$	$5 \times 10^{+1(b)}$
Inhalation of VOCs from Soil		2×10^{0}	2×10^{0}
TOTAL NONCANCER RISK	**$2 \times 10^{+1(a)}$**	**$5 \times 10^{+1}$**	**$6 \times 10^{+1}$**

(a) Risk due to total metals is $1 \times 10^{+1}$.
(b) Noncancer risk without chromium is Hazard Index (HI) < 1.

F:\PROJ\6098401\POOL\ROD\DFT_FNL\TABLES\TABLE7.WPD

TABLE 8 SUMMARY OF CARCINOGENIC RISKS FROM FUTURE EXPOSURE SCENARIOS

Exposure Routes/Media	Future Off-Post Residents	Future Commercial/Industrial Workers (Dissolved Metals)	Future Commercial/Industrial Workers (Total Metals)
Ingestion of Ground Water	2×10^{-1}	2×10^{-2}	2×10^{-2}
Ingestion of Soil		2×10^{-6}	2×10^{-6}
Dermal Contact With Ground Water	7×10^{-3}		
Dermal Contact With Soil		2×10^{-6}	2×10^{-6}
Inhalation of VOCs From Ground Water	5×10^{-6}		
Inhalation of Particulates From Soil		4×10^{-4}(b)	4×10^{-4}(b)
Inhalation of VOCs From Soil		2×10^{-5}	2×10^{-5}
TOTAL CANCER RISK	**2×10^{-1}(a)**	**2×10^{-2}**	**2×10^{-2}**

(a) Risk is the same for total and dissolved metals.
(b) Cancer risk without chromium for this exposure group is 1×10^{-5}.

F:\PROJ\6098401\POOL\ROD\DFT_FNL\TABLES\TABLE8.WPD

TABLE 5 SUMMARY OF NONCARCINOGENIC RISKS (HIs) FROM CURRENT EXPOSURE SCENARIOS

Exposure Routes/Media	Exposure Groups						
	Current Lake City Residents	Lake City Well C Residents	Mowers	Construction Workers (Dissolved Metals)	Construction Workers (Total Metals)	National Guardsmen	Meat-Eaters
Duration of Exposure	Chronic	Chronic	Chronic	Subchronic	Subchronic	Chronic	Chronic
Ingestion of Ground Water	5×10^{-1}	3×10^{-1}		2×10^{-3}	1×10^{-3}		
Ingestion of Soil			9×10^{-3}	3×10^{-2}	3×10^{-2}	2×10^{-2}	
Dermal Contact With Ground Water	7×10^{-3}	2×10^{-3}		5×10^{-3}	1×10^{-3}		
Inhalation of VOCs From Ground Water	2×10^{-6}	0		2×10^{-1}	2×10^{-1}		
Inhalation of Particulates From Soil[a]			3×10^{0}	$5 \times 10^{+1(b)}$	$5 \times 10^{+1(b)}$	$1 \times 10^{+1(b)}$	
Inhalation of VOCs From Soil			1×10^{-1}	6×10^{-1}	6×10^{-1}	4×10^{-1}	
Ingestion of Meat							$1 \times 10^{+1}$
TOTAL NONCANCER RISK	6×10^{-1}	3×10^{-1}	3×10^{0}	$5 \times 10^{+1(b)}$	$5 \times 10^{+1(b)}$	$1 \times 10^{+1(b)}$	$1 \times 10^{+1}$

(a) See discussion on Inhalation risks driven by chromium.
(b) Noncancer risk without chromium is Hazard Index (HI) < 1.

TABLE 6 SUMMARY OF CARCINOGENIC RISKS FROM CURRENT EXPOSURE SCENARIOS

Exposure Routes/Media	Exposure Groups						
	Current Lake City Residents	Lake City Well C Residents	Mowers	Construction Workers (Dissolved Metals)	Construction Workers (Total Metals)	National Guardsmen	Meat-Eaters
Ingestion of Ground Water	9×10^{-5}	8×10^{-5}		2×10^{-8}	4×10^{-8}		
Ingestion of Soil			3×10^{-7}	6×10^{-7}	6×10^{-7}	2×10^{-7}	
Dermal Contact With Ground Water	2×10^{-6}	1×10^{-6}		4×10^{-8}	6×10^{-8}		
Inhalation of VOCs From Ground Water	5×10^{-10}	0		5×10^{-6}	5×10^{-6}		
Inhalation of Particulates From Soil			3×10^{-5}	8×10^{-5}	8×10^{-5}	4×10^{-5}	
Inhalation of VOCs From Soil			2×10^{-6}	2×10^{-6}	2×10^{-6}	2×10^{-6}	
Ingestion of Meat							6×10^{-6}
TOTAL CANCER RISK	9×10^{-4}	8×10^{-4}	3×10^{-4}	9×10^{-4}	9×10^{-4}	4×10^{-5}	6×10^{-4}

F:\PROJ\6098401\POOL\ROD\DFT_FNL\TABLE6.WPD

Discharge Option #1 **1a, 2a, 3a, only** **(Discharge to LBVSD)**	33 USC 1251-1376 40 CFR 403.5		Clean Water Act (CWA) Pursuant to this alternative and discharge option, contaminated ground water will be extracted and treated in the Area 18 treatment plant prior to being discharged to the Little Blue Valley Sewer District (LBVSD). The CWA requires that the discharge comply with LBVSD pretreatment program. General pretreatment regulations are located at 40 CFR 403. 40 CFR 403.5 includes general and specific prohibitions on discharges to POTWs. For this discharge option, the discharge would be regulated under permit #LB-0200-LC504. Discharge requirements of this permit are included in Appendix C. Since the discharge is off-site and is regulated pursuant to a permit, it is not considered an ARAR, but is a compliance requirement
Discharge Option #2 **1b, 2b, 3b, only** **(Discharge to Ditch B)**	40 CFR §§ 301, 302, 306, 307 10 CSR 20-7.031	Applicable	Pursuant to this alternative and discharge option, contaminated ground water will be extracted and treated in the Area 18 treatment plant prior to being discharged to Ditch B onsite. Onsite discharges must meet the substantive requirements of the CWA NPDES program. Applicable discharge criteria under the NPDES program are found in 40 CFRs 301, 302, 306, and 307
	10 CSR 20-6.010 10 CSR 20-7.015	Applicable	Construction of a second outfall from the air stripper would require adherence to substantive requirements of the current in-place NPDES Permit pursuant to Missouri Clean Water Law [10 CSR 20-6.010(1)]. Any modification to a sewer system or water contamination source or point source would require adherence to substantive requirements of 10 CSR 20-6.101(4). 10 CSR 20-7.015 regulates the limits for various pollutants which are discharged to the various waters of the State of Missouri.

Discharge Option #3 **1C, 2C, 3C, only** **(Discharge through Underground Injection)**	10 CSR 20-6	Applicable	The injection of hazardous wastes from CERCLA sites into wells must meet the substantive requirements of the Safe Drinking Water Act (SDWA) Underground Injection Control (UIC) Program. Underground injection wells are divided into 5 different classes, standards and criteria depend on the classification of the well. Of the 5 classes, Class I, IV and V wells are most likely to be involved with CERCLA actions (CERCLA Compliance With Other Laws Manual Interim Final, 1988). The specific requirements can only be identified after the well classifications are determined. Missouri regulates the construction and operating of such wells under 10 CSR 20-6. Substantive requirements of 10 CSR 20-6 must be reviewed to identify ARARs. If underground injection is selected, these requirements would be addressed in the RD/RA which is subject to review according to provisions of the FFA.

Notes: Because the State of Missouri has received RCRA base authorization for certain parts of the RCRA Hazardous and Solid Waste Amendments (HSWA) of 1984 to administer and enforce the RCRA hazardous waste management programs in lieu of the federal program, the State hazardous waste regulations will provide ARARs. In addition, the State of Missouri in many instances incorporates by reference the federal hazardous requirements and sets forth State requirements which modify or add to the federal requirements and the State has modified or added to the federal regulations, the federal citation has also been provided in the action-specific ARARs table.

DESCRIPTION OF REMEDIAL ALTERNATIVES AND SUMMARY OF ACTION-SPECIFIC ARARs

REMEDIAL ALTERNATIVE DESCRIPTION	ACTION-SPECIFIC ARARs	ARAR STATUS	COMMENTS
SOURCE-AREA ALTERNATIVES			
Alternative SA-1: No Action	NA	NA	
Alternative SA-2: Containment - Capping and Vertical Barriers • Erosion and sediment control and stormwater management provisions • Installation of a cap • Installation of a vertical barrier • Revegetation of the cap	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7
	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during installation of the cap. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7

Alternative SA-3: Excavation with Onsite Thermal Treatment, Replacement and 2-ft. Cover	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7
• Erosion and sediment control and stormwater management provisions • Selective excavation of inactive waste lagoons	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during installation of the cover. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7.
• Collection of ground water infiltrating into the excavation and onsite treatment	10 CSR 20-6.200	Applicable	ARARs regarding storm water management are the same as described under Alternative SA-7
• Set up of low temperature thermal shipping facility onsite • Treatment of excavated materials and backfill onsite • Installation of 2-ft. cover • Revegetation of disturbed area	40 CFR § 264, Subpart X 40 CFR § 265.373 through 265.381	Applicable	The low temperature thermal treatment unit is classified as a miscellaneous treatment unit under RCRA and 40 CFR Part 264. 10 CSR 25-7.264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, is the state rule that corresponds to 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities. The State of Missouri does not have any provisions pertaining to miscellaneous treatment units. Therefore, the requirements in 40 CFR § 264, Subpart X would provide ARARs. 40 CFR 264, Subpart X sets forth design, operational, and monitoring requirements for miscellaneous treatment units to ensure operations are protective of human health and the environment. It also references requirements of 40 CFR 264 Subparts I through O and AA through CC. Also, the thermal treatment requirements of 40 CFR 265.373-381 would be applicable if the excavated soil is to be treated in a device other than an enclosed device using controlled flame combustion, unless 40 CFR 265.1 provides otherwise. The design, operating, and monitoring parameters of the treatment unit will be specified in the RD/RA workplan which is subject to approval according to FFA provisions.

SA-3 (Continued)	40 CFR § 264, Subpart L 10 CSR 25-7 264(2)(L)	Applicable	If the contaminated soil is determined to be hazardous and is staged in piles before treatment, the Army is determined to be a large quantity generator, and the excavated soil remains in this area for more than 90 days, then the remediation area is defined as a waste pile. The State of Missouri at 10 CSR 25-7 264(2)(L) incorporates by reference and sets forth standards which modify or add to the federal requirements for waste piles in 40 CFR Part 264, Subpart L. In order to be exempted from the waste pile requirements in 40 CFR § 264, Subpart L, which Missouri incorporates by reference; 40 CFR Part 264, Subpart F, which Missouri incorporates by reference; and 10 CSR 25-7.264(2)(L), the waste pile must meet the following requirements: liquids or materials containing free liquids are not placed in the pile, the pile is protected from surface water run-on by the structure or in some other manner, the pile is designed and operated to control dispersal of the waste by wind, where necessary, by means other than wetting; the pile will not generate leachate through decomposition or other reactions; and the pile must be at least ten feet above the historical high groundwater table. If the waste pile cannot meet the above stated requirements for exemption, then the design and operating requirements and closure and post-closure requirements will provide ARARs.
	40 CFR § 261 40 CFR § 264 40 CFR § 268	Applicable	ARARs under RCRA relate to disposal of waste materials excavated from the site during construction and implementation of the remedial alternative, where the soil exhibits hazardous characteristics (i.e., the TCLP test exceeds regulatory levels). Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. 40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. Chemicals found in the soil at Area 18 and the corresponding regulatory limits for the toxicity characteristic are: mercury (0.2 mg/L); lead (5.0 mg/L); PCE (0.7 mg/L); TCE (0.5 mg/L); total cresol (200 mg/L); vinyl chloride (0.2 mg/L); benzene (0.5 mg/L); and 1,1 DCE (0.7 mg/L).

SA-3 (Continued)			Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. If it is and the hazardous soil is disposed of onsite, LDRs (40 CFR 268) would be applicable. Also, if the waste is determined to be hazardous, RCRA storage requirements under 40 CFR 264 would be applicable. Because the contaminated soil will be excavated, treated in a separate unit, and replaced in the excavation as backfill, placement will occur. Placement must comply with LDR treatment standards found in 40 CFR 268. Hazardous soils are generally subject to the LDR treatment standards that apply to the hazardous wastes with which the soils are contaminated. Treatment standards for listed wastes and for wastes exhibiting the toxicity characteristic are published in 40 CFR § 268.40. Soils containing a specific waste can be land disposed as long as the concentration of the waste in the soil is below the specified treatment standard. The procedures for obtaining a treatability variance are described at 40 CFR § 268.44. If hazardous, material generated during construction of the Area 18 remedy will be subject to applicable provisions of RCRA for disposal as a hazardous waste. Sediments and/or sludge removed from the Area 18 treatment system during operation and spent catalyst from the catalytic oxidation unit will have to be disposed of according to 40 CFR 268 if they exhibit hazardous characteristics. If the residuals from the treatment unit are determined to be hazardous waste and will be disposed of onsite, the LDRs will be applicable. LDRs require that RCRA hazardous wastes be treated to protective levels specified in 40 CFR 268 prior to land disposal

Alternative SA-5: Excavation with Offsite Treatment and Disposal • Erosion and sediment control and stormwater management provisions • Selective excavation of inactive waste lagoons • Collection of ground water infiltrating into the excavation and onsite treatment • Transportation of excavated material offsite for treatment and disposal • Backfilling of excavated areas with clean fill, regrading, revegetation	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K) 10 CSR 10-6.170 10 CSR 20-6.200 40 CFR § 261 40 CFR § 264	Relevant and Appropriate Applicable Applicable Applicable	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7 Fugitive dust emissions may be produced during excavation. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7 ARARs regarding storm water management are the same as described under Alternative SA-7 ARARs under RCRA relate to disposal of waste materials excavated from the site during construction and implementation of the remedial alternative, where the soil exhibits hazardous characteristics (i.e., the TCLP test exceeds regulatory levels). 40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. Chemicals found in the soil at Area 18 and the corresponding regulatory limits for the toxicity characteristic are: mercury (0.2 mg/L), lead (5.0 mg/L); PCE (0.7 mg/L); TCE (0.5 mg/L); total cresol (200 mg/L); vinyl chloride (0.2 mg/L), benzene (0.5 mg/L); and 1,1 DCE (0.7 mg/L). Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. Since the contaminated soil will be disposed of offsite, LDRs are not ARARs (although transporters and disposal facilities must comply with applicable RCRA regulations under 40 CFR 264 and 40 CFR 268). However, if the waste is determined to be hazardous, RCRA storage requirements under 40 CFR 264 would be applicable. If hazardous, material generated during construction of the Area 18 remedy will be subject to applicable provisions of RCRA for disposal as a hazardous waste.

SA-6 Option 1/SA-8 Option 2a Land Farming • Land farming of contaminated soil without air controls. Land farming under this option will be performed in an open area without any air control system. • Excavate VOC-contaminated soil to a depth of approx. 20 ft. • Spread 2 ft. soil layer on the sand. • Backfill with treated soil.	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7.
	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during excavation. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7.
	10 CSR 20-6.200	Applicable	ARARs regarding storm water management are the same as described under Alternative SA-7.
	42 U.S.C. 7401-7642		Clean Air Act (CAA)
	40 CFR § 50 10 CSR 10-6.010 10 CSR 10-6.060 40 CFR § 61 10 CSR 10-6.080	Applicable	The landfarming operation would be subject to the air pollution control standards of the Clean Air Act. 40 CFR 50 specifies Ambient Air Quality Standards for sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, particulate matter, and lead that are protective of public health. 10 CSR-6.010, Ambient Air Quality Standards, has the same requirements as 40 CFR 50 and adds ambient air quality standards for hydrogen sulfide and sulfuric acid. 40 CFR 61 establishes emissions standards for benzene, beryllium, mercury, and vinyl chloride. 10 CSR 10-6.080 adopts the requirements of 40 CFR 61 these constituents. Benzene, beryllium, mercury, and vinyl chloride may be present at Area 18. 10 CSR 10-6.060 establishes *de minimus* levels for ozone emissions of 40 tons per year and vinyl chloride emissions of 1 ton per year. The rate of landfarming would be conducted to be protective of human health and the environment and would meet the applicable emission standards. Operating parameters would be listed in the RD/RA workplan which is subject to approval according to FFA provisions.
	40 CFR § 264, Subpart L 10 CSR 25-7.264(2)(L)	Applicable	ARARs regarding the use of piles to stage excavated materials are the same as described under Alternative SA-3.

SA-6 Option 1 /SA-8 Option 2a (Continued)	40 CFR § 261 40 CFR § 264 40 CFR § 268	Applicable	Although the treatment processes are different under Alternatives SA-3 and SA-6 Option 1/SA-8 Option 2a, these ARARs for the two alternatives are similar. Refer to Alternative SA-3 for a description of RCRA ARARs.
SA-6 Option 2/SA-8 Option 2b Land Farming	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7.
• Land farming of the contaminated soil with air controls. This will include collection and treatment of vapors generated during land farming. Land farming under this option will be performed in a closed structure • Excavate VOC-contaminated soil to a depth of approx. 20 ft. • Backfill with treated soil	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during excavation. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7.
	10 CSR 20-6.200	Applicable	ARARs regarding storm water management are the same as described under Alternative SA-7.
	40 CFR § 264.1101 40 CFR § 264.1102	Applicable	Pursuant to this remedial alternative, the land farming technology will be performed using air controls. If the method of controlling air emissions is classified as a containment building under RCRA, the design and operating requirements at 40 CFR § 264.1101 and the closure and post-closure care requirements at 40 CFR § 264.1102 are ARARs. The State of Missouri has no equivalent provisions to 40 CFR § 264.1101, Design and Operating Standards for Containment Buildings, and 40 CFR § 264.1102, Closure and Post-closure Care.

	42 U.S.C. 7401-7642		Clean Air Act (CAA)
SA-6 Option 2/SA-8 Option 2b Land Farming (continued)	40 CFR § 50 10 CSR 10-6.010 10 CSR 10-6.060	Applicable	The landfarming operation would be subject to the air pollution control standards of the Clean Air Act. Emissions from the landfarming vapor treatment unit will meet the applicable federal and state criteria under the standards of the Clean Air Act. 40 CFR 50 specifies Ambient Air Quality Standards for sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, particulate matter, and lead that are protective of public health. 10 CSR-6.010, Ambient Air Quality Standards, has the same requirements as 40 CFR 50 and adds ambient air quality standards for hydrogen sulfide and sulfuric acid. 40 CFR 61 establishes emissions standards for benzene, beryllium, mercury, and vinyl chloride. 10 CSR 10-6.080 adopts the requirements of 40 CFR 61 for these constituents. Benzene, beryllium, mercury, and vinyl chloride may be present at Area 18. 10 CSR 10-6.060 establishes *de minimus* levels for ozone emissions of 40 tons per year and vinyl chloride emissions of 1 ton per year. The rate of landfarming would be conducted to be protective of human health and the environment and would meet the applicable emission standards. Operating parameters would be listed in the RD/RA workplan which is subject to approval according to EPA provisions.
	40 CFR § 61 10 CSR 10-6.080	Relevant and Appropriate	
	40 CFR § 261 40 CFR § 264 40 CFR § 268	Applicable	ARARs under RCRA relate to disposal of waste materials excavated from the site during construction and implementation of the remedial alternative, where the soil exhibits hazardous characteristics (i.e., the TCLP test exceeds regulatory levels). Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. 40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. Chemicals found in the soil at Area 18 and the corresponding regulatory limits for the toxicity characteristic are: mercury (0.2 mg/L); lead (5.0 mg/L); PCE (0.7 mg/L); TCE (0.5 mg/L); total cresol (200 mg/L); vinyl chloride (0.2 mg/L); benzene (0.5 mg/L); and 1,1 DCE (0.7 mg/L).

SA-6 Option 2/SA-8 Option 2b Land Farming (continued)			Since the contaminated soil will be disposed of offsite, LDRs are not ARARs (although transporters and disposal facilities must comply with applicable RCRA regulations under 40 CFR 264 and 40 CFR 268). However, if the waste is determined to be hazardous, RCRA storage requirements under 40 CFR 264 would be applicable. Because the contaminated soil will be excavated, treated in a separate unit, and replaced in the excavation as backfill, placement will occur. Placement must comply with LDR treatment standards found in 40 CFR 268. Hazardous soils are generally subject to the LDR treatment standards that apply to the hazardous wastes with which the soils are contaminated. Treatment standards for listed wastes and for wastes exhibiting the toxicity characteristic are published in 40 CFR § 268.40. Soils containing a specific waste can be land disposed as long as the concentration of the waste in the soil is below the specified treatment standard. The procedures for obtaining a treatability variance are described at 40 CFR § 268.44. If hazardous, material generated during construction of the Area 18 remedy will be subject to applicable provisions of RCRA for disposal as a hazardous waste. Also, sediments and/or sludge removed from the Area 18 treatment system during operation and spent catalyst from the catalytic oxidation unit will have to be disposed of according to 40 CFR 268 if they exhibit hazardous characteristics. If the residuals from the treatment unit are determined to be hazardous waste and will be disposed of onsite, the LDRs will be applicable. LDRs require that RCRA hazardous wastes be treated to protective levels specified in 40 CFR 268 prior to land disposal.

SA-7 In-Situ Soil Vapor Extraction and Treatment • Soil vapor extraction using a multi-phase extraction system and treatment of extracted ground water and vapors to address VOC (volatile organic compound)-contaminated soil and shallow ground water in source areas • Excavation and disposal of lead-contaminated soil. • Ground water extraction and treatment. • Institutional controls to limit future site use. • Long-term monitoring.	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. The State of Missouri at 10 CSR 25-7.264(2)(K) incorporates by reference and sets forth standards which modify or add to the federal requirements for surface impoundments in 40 CFR Part 264, Subpart K. The closure and post-closure requirements in 40 CFR § 264, Subpart K and 10 CSR 25-7.264(2)(K) are relevant and appropriate.
	42 U.S.C. 7401-7642		Clean Air Act (CAA)
	40 CFR § 50 10 CSR 10-6.010 10 CSR 10-6.060	Applicable	Pursuant to this alternative, extracted ground water and vapors will be treated at the Area 18 treatment plant. CAA requirements for this remedial alternative are the same as described under Alternative GW-3/GW-4. Refer to Alternative GW-3/GW-4 for discussion.
	40 CFR § 61 10 CSR 10-6.080	Relevant and Appropriate	
	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced from the excavation activities. The State of Missouri at 10 CSR 10-6.170 restricts persons from causing or allowing fugitive particulate matter to go beyond the premises where such matter originates. The limitations on the quantities as well as exceptions to the rule are described in detail at 10 CSR 10-6.170.
	10 CSR 20-6.200	Applicable	The requirements of 10 CSR 20-6.200 apply to all persons who disturb land that may result in a storm water point source. The regulations require that Best Management Practices (BMPs) for controlling storm water runoff, erosion, and sediment transport must be employed. BMPs include actions such as the use of stabilized construction entrances and roads, silt fences, dikes, sediment retention ponds, erosion control mats/blankets, and/or planting vegetation. The types and locations of sediment and erosion control measures will be determined during remedial design and will be addressed in the construction work plan or remedial design documents. Vegetative stabilization procedures, practices, and standards will be consistent with LCAAP standards and MDNR requirements.

SA-7 In-Situ Soil Vapor Extraction and Treatment (continued)	42 USC 300(g)		Safe Drinking Water Act (SDWA)
	40 CFR § 141 10 CSR 60	Relevant and Appropriate	Requirements of the SDWA are the same as under Alternative GW-3/GW-4. Refer to Alternative GW-3/GW-4 for discussion
	33 USC 1251-1376		Clean Water Act (CWA)
	40 CFR 403.5		Requirements of the CWA are the same as under Alternative GW-3/GW-4 Discharge Option #1 (Area 18 treatment plant discharges treated ground water to the LBVSD). Refer to Alternative GW-3/GW-4 Discharge Option #1 for discussion
	10 CSR 23-4.030 10 CSR 23-4.060 10 CSR 23-4.070	Applicable	As a part of this remedial alternative, extraction wells will be constructed. The substantive requirements of the Rules of the Missouri Department of Natural Resources, Division of Geology and Land Survey, Chapters 1 through 6 apply to all wells at LCAAP. Extraction wells used in site remediation are regulated by Chapter 4, titled "Monitoring Well Construction Code," and are included in the definition of "monitoring wells." Among other things, the Chapter 4 rules set forth criteria for the general protection of groundwater quality and resources. Criteria for the placement of wells is specified in 10 CSR 23-4.030. 10 CSR 23-4.060 specifies construction standards. However, according to 10 CSR 23-4.060, the standards for construction of extraction wells is determined on a case-by-case basis by the division. These details will be provided in the RD/RA workplan subject to review according to FFA provisions

SA-7 (Continued)	40 CFR § 261 40 CFR § 264 40 CFR § 268	Applicable	For the Area 18 remediation, ARARs under RCRA relate to disposal of waste materials excavated from the site during construction and implementation of the remedial alternative, where the soil exhibits hazardous characteristics (i.e., the TCLP test exceeds regulatory levels). 40 CFR Part 261 lists the maximum concentration of contaminants for the toxicity characteristic based on TCLP testing. Chemicals found in the soil at Area 18 and the corresponding regulatory limits for the toxicity characteristic are: mercury (0.2 mg/L); lead (5.0 mg/L); PCE (0.7 mg/L); TCE (0.5 mg/L); total cresol (200 mg/L); vinyl chloride (0.2 mg/L); benzene (0.5 mg/L); and 1,1 DCE (0.7 mg/L). Soil that is excavated will be tested to determine if it is a RCRA hazardous waste. If it is and the hazardous soil is disposed of onsite, LDRs (40 CFR 268) would be applicable. If determined to be hazardous, contaminated media generated during construction of the Area 18 remedy will be subject to applicable provisions of RCRA for disposal as a hazardous waste. Also, sediments and or sludge removed from the Area 18 treatment system during operation and spent catalyst from the catalytic oxidation unit will have to be disposed of according to 40 CFR 268 if they exhibit hazardous characteristics.

SA-8 Selective Excavation and Treatment Option 1 • Selective excavation with treatment by low temperature thermal desorption (LTTD)	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7.
	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during installation of the cover. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7.
	10 CSR 20-6.200	Applicable	ARARs regarding storm water management are the same as described under Alternative SA-7.
	40 CFR § 264, Subpart X 40 CFR §§ 265.373 through 265.381	Applicable	ARARs regarding the LTTD unit are the same as described under Alternative SA-3.
	40 CFR § 264, Subpart L 10 CSR 25-7.264(2)(L)	Applicable	ARARs regarding the use of piles to stage excavated materials are the same as described under Alternative SA-3.
	40 CFR § 261 40 CFR § 264 40 CFR § 268	Applicable	These RCRA ARARs are the same as described under Alternative SA-3.

SA-8 Selective Excavation and Treatment Option 3 • Soil will be excavated and transported off-site for treatment and disposal	40 CFR 264, Subpart K 10 CSR 25-7.264(2)(K)	Relevant and Appropriate	The lagoons at Area 18 are surface impoundments. ARARs are the same as discussed under Alternative SA-7
	10 CSR 10-6.170	Applicable	Fugitive dust emissions may be produced during excavation. ARARs regarding fugitive dust emissions are the same as described under Alternative SA-7.
	10 CSR 20-6.200	Applicable	ARARs regarding storm water management are the same as described under Alternative SA-7.
	40 CFR § 261 40 CFR § 264	Applicable	These RCRA ARARs are the same as described under Alternative SA-5.

Notes: Because the State of Missouri has received RCRA base authorization for certain parts of the RCRA Hazardous and Solid Waste Amendments (HSWA) of 1984 to administer and enforce the RCRA hazardous waste management programs in lieu of the federal program, the State hazardous waste regulations will provide ARARs. In addition, the State of Missouri in many instances incorporates by reference the federal hazardous requirements and sets forth State requirements which modify or add to the federal requirements and the State has modified or added to the federal regulations, the federal citation has also been provided in the action-specific ARARs table.

Location-Specific ARARs

LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR LAKE CITY ARMY AMMUNITION PLANT[a]

Location	Requirement	Prerequisite(s)	Citation
Within area affecting stream or river—and—presence of fish or wildlife resources	Must take action to protect fish or wildlife resources; prohibits diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife. Federal agencies should consult with the Fish and Wildlife Service and State personnel to develop protective measures for affected wildlife.	Presence of fish and wildlife resources; action by Federal agencies resulting in the control or structural modification of a natural stream or body of water. Offsite response actions.	Fish and Wildlife Coordination Act (16 USC 661 et seq); 40 CFR 6.302(g) (1994)
Presence of wetlands as defined in Executive Order 11990 § 7[c] and 40 CFR § 6, Appendix A § 4(j) (1994)	• Whenever possible, actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. New construction in wetlands areas should be particularly avoided unless there are no practicable alternatives. • Wetlands protection considerations shall be incorporated into planning, regulating, and decision-making processes.	Action which involves: • Acquiring, managing, and disposing of lands and facilities. • Providing Federally undertaken finances, or assisted construction and improvements. • Conducting Federal activities and programs affecting land use.	• Executive Order 11990 • 40 CFR § 6.302(a) (1994) • 40 CFR § 6, Appendix A (1994)
Presence of wetlands as defined in 40 CFR § 230.3(t) (1994) and 33 CFR § 328.3(b)[a]	• Action must be taken to avoid degradation or destruction of wetlands to the extent possible. Discharges for which there are practicable alternatives with less adverse impacts or those which would cause or contribute to significant degradation are prohibited. • If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	Action involving discharge of dredge or fill material into wetlands.	• Clean Water Act § 404 (33 USC § 1344 (1991 • 40 CFR § 230 (1994) • 33 CFR § 320-330[a]

(a) Adapted from EPA (1994).
(b) There are no comparable State requirements.

LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR LAKE CITY ARMY AMMUNITION PLANT[a] (Continued)

Location	Requirement	Prerequisite(s)	Citation
Floodplains			
• Within 100-year floodplain	• Treatment, storage or disposal facility • RCRA[a] - defined listed or characteristic hazardous waste (40 CFR 261) -or- RCRA-permitted facility	• Facility must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by 100 year flood	• 40 CFR 264.18(b)
• Within "lowland and relatively flat areas adjoining inland and coastal waters and other flood prone areas such as offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year." [Executive Order 11988 § 6[c] and 40 CFR 6, Appendix A § 4(d)]	• Action which involves: - acquiring, managing, and disposing of lands and facilities - providing federally undertaken, financed, or assisted construction and improvements - conducting federal activities and programs affecting land use	• Action shall be taken to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values of floodplains. • The potential effects of actions in floodplains shall be evaluated and consideration of flood hazards and floodplain management ensured. • If action is taken in floodplains, alternatives to avoid adverse effects, incompatible development, and minimize potential harm shall be considered	• Executive Order 11988 • 40 CFR 6.302(b) • 40 CFR 6 (Appendix A)

(a) Adapted from EPA (1994).
(b) There are no comparable State requirements.

Additional ARARs Provided by the State of Missouri for the Selected Remedy

TABLE 1: CHEMICAL-SPECIFIC REQUIREMENTS

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation
lead*	1.5 micrograms per cubic meter using method specified in 10 CSR 10-6.040(4)(G); Calendar quarter arithmetic mean not to be exceeded †AALs: for lead 0.36 micrograms per cubic meter (24 hour averaging time); for lead acetate 0.01 micrograms per cubic meter (24 hr. avg. time); for lead compounds 2.00 micrograms per cubic meter (8 hr. avg. time)	ambient air	Provides the regulatory maximum allowable level of lead in ambient air for protection of public health and welfare. AALs are calculated for acceptable fenceline concentrations for protection of public health and welfare.	10 CSR 10-6.010, "Ambient Air Quality Standards." 10 CSR 10-6.040, "Reference Methods." N/A
particulate matter 10 micron* (PM_{10})	50 micrograms per cubic meter annual arithmetic mean; method as specified in 10 CSR 10-6.040(4)(J) 150 micrograms per cubic meter 24-hour average concentration as determined 10 CSR 10-6.040(4)(K)	ambient air	Provides the regulatory maximum allowable level of particulate matter for protection of public health and welfare.	10 CSR 10-6.010, "Ambient Air Quality Standards." 10 CSR 10-6.040, "Reference Methods."
Others	See attached list of AAL's	ambient air	AAL's are calculated for acceptable fenceline concentration for protection of public health and welfare.	Refer to list

*Lead and particulate matter are two of eight pollutants for which ambient air quality standards have been promulgated in this section of the state rule. The other six are: sulfur dioxide, carbon monoxide, photochemical oxidants (ozone), nitrogen dioxide, hydrogen sulfide and sulfuric acid.

†A current list of draft AAL's (Acceptable Ambient Levels) is attached. AAL's in this list were developed by the Mo Dept of Health, MDOH/MDNR, taken from an existing standard, or adjusted for ambient exposure from an existing standard as indicated in the "Source" column. The AAL's in this list refer to acceptable *fenceline concentrations*.

<TABLE 2: LOCATION SPECIFIC REQUIREMENTS>

The Lake City Army Ammunition Plant is located in Independence, Missouri, Jackson County. Jackson County, with the exception of Kansas City proper, is in the jurisdiction of the Air Pollution Control Program (as opposed to one of the delegated local agencies.) In general, the sections of the air pollution regulations which apply to this area are Chapter 2, "Air Pollution Control Rules Specific to the Kansas City Metropolitan Area," and Chapter 6, "Air Quality Standards, Definitions, Sampling and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri." The preceding table, TABLE 1, and the following table, TABLE 3, attempt to specify the possible applicable regulations from these two chapters. Additionally, TABLE 1 lists some non-codified information which may be considered relevant.

TABLE 3: ACTION SPECIFIC REQUIREMENTS

Action subject to Requirement	**Requirement**	**Reason Why Requirement is an ARAR**	**Regulatory Citation**
Existence of visible emissions[b]	Specifies the maximum allowable shade or opacity of visible air contaminant emissions	Limits visible emissions at the site, (from excavation, access roads, etc.), thereby limiting the release of contaminants into the ambient air	10 CSR 10-2.060, "Restriction of Emission of Visible Air Contaminants"
Existence of odors	Restricts the emission of excessive odorous matter	Protects the surrounding property owners from excessive odors	10 CSR 10-2.070, "Restriction of Emission of Odors"
Open burning	Restricts open burning of refuse, trade wastes, etc.	Prevents release of ambient air contaminants from open burning	10 CSR 10-2.100, "Open Burning Restrictions"
Particulate emissions leaving property of origin[c]	Restricts the emission of particulate matter to the ambient air beyond the premises of origin. (This applies not only to the operation itself, but also to the construction and use of the non-public access roads on site	Restricts particulate emissions from the site (from excavation, access roads, etc.) to the property of origin, thereby protecting the surrounding property from contamination	10 CSR 10-6.170, "Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin"
Emission of air contaminants	Upon request, any source shall complete, or have completed, tests of emissions or, at the option of the agency, make the source available for tests of emissions.	Provides data necessary to determine if engineering controls used for the operation are preventing the release of air contaminants into the ambient air	10 CSR 10-6.180, "Measurement of Emissions of Air Contaminants"

[b]Due to the fact that the operation in question involves chemicals with known or potential serious health effects, the Air Pollution Control Program recommends that ***no visible emissions*** be allowed from the operation.

Summary and Recommendations:

These tables listing ARARs are based on the information provided in the Draft ROD. The major components of the project that are of concern to the Air Program are soil vapor extraction (Multi-Phase Vacuum System - MPVE) and treatment of vapors, excavation and consolidation of lead-contaminated soil, earth cover to address surface soils, and ground water treatment (air stripping/catalytic oxidation). The following state rules are not listed as ARARs for the reasons given:

> 10 CSR 10-6.070, "New Source Performance Regulations." which establishes acceptable design and performance criteria for specific source categories construction new or modified emission sources.
>
> 10 CSR 10-6.075, "Maximum Achievable Control Technology Regulations," which establish emission control technology, performance criteria and work practices for *specific source categories* that emit or have the potential to emit hazardous air pollutants.
>
> 10 CSR 10-6.080, "Emission Standards for Hazardous Air Pollutants," establishes emission standards and performance criteria for *specific source categories* emitting hazardous air pollutants.
>
> 10 CSR 10-6.240, "Asbestos Abatement Projects - Registration, Notification and Performance Requirements," and 10 CSR 10-6.250, "Asbestos Abatement Projects - Certification, Accreditation and Business Exemption Requirements," which regulate the handling and disposal of asbestos containing materials.

The regulations allow for a prescribed amount of visible emissions. However, due to the nature of the contaminants, it is recommended that ***no visible emissions*** be allowed from the excavation and handling of the contaminated materials.

Ambient Air Quality Standards for lead and particulate matter (as well as sulfur dioxide, carbon monoxide, photochemical oxidants (ozone), nitrogen dioxide, hydrogen sulfide, and sulfuric acid) are codified in the state regulations. The "acceptable ambient levels" are not codified specifically. However, health-based AALs exist for many of the chemicals present at this site. The AAL's are used in the permitting process. (Current list attached.)

Many of the chemicals present are also categorized as hazardous air pollutants (HAPs). The *de minimis* level of HAPs is 10 tons/year for any single HAP or 25 tons/year for any combination of two or more HAPs. (*De minimis* levels are used to determine the level of regulatory review. They do not represent determined "safe" levels.)

The concentration of air contaminants at the fenceline should remain below the Acceptable Ambient Levels provided in the attached list. Adequate modeling/monitoring of the ambient air for air contaminants should be implemented to determine if engineering controls are sufficient to protect public health and the environment.

This is a Superfund project and therefore is not required to obtain an actual permit, but is required to meet the substantive requirements of the state rules. Missouri State Rules, 10 CSR 10-6.060, "Construction Permits Required," and 10 CSR 10-6.065, "Operating Permits Required," provide a mechanism for the state to review sources of air pollution and determine if they are in compliance with the air pollution control requirements, AAL's, laws and guidances. Adherence to the AAL's and performance of adequate monitoring to determine this should be considered the substantive requirements of these two rules.

October 20, 1997

ADDENDUM

Please be aware of the data that this report does not present:

1. The report does not contain the CAS Numbers for nickel refinery dust, dipropylene glycol methyl ether acetate, and tripropylene glycol methyl ether.

2. The report incorrectly lists the asbestos AAL units as $\mu g/m^3$, rather than the correct units, fibers/mL.

3. The report does not list the following pollutants' 1-hour AALs:

   - Bromine (CAS# 7726-95-6), 0.33 mg/m^3.
   - Dichloroethyl ether (CAS# 111-44-4), 0.287 mg/m^3.
   - Dimethylamine (CAS# 124-40-3), 49 $\mu g/m^3$.
   - Hydrogen Cyanide (CAS# 74-90-8), 11 mg/m^3.

DRAFT ACCEPTABLE AMBIENT LEVELS FOR MISSOURI
(*AAL CONCENTRATION = ug/m3)

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
ACEPHATE	30560-19-1						
ACETALDEHYDE	75-07-0			2.00000	Massachusetts DEP	0.500000	Massachusetts DEP
ACETAMIDE	60-35-5						
ACETIC ACID	64-19-7	333.33000	ACGIH TLV				
ACETONE	67-64-1			160.54000	Massachusetts DEP	160.540000	Massachusetts DEP
ACETONITRILE	75-05-8	933.33000	ACGIH TLV				
ACETOPHENONE	98-86-2						
ACETYLAMINOPLUORINE, [2-]	53-96-3						
ACETYLENE	74-86-2						
ACROLEIN	107-02-8	0.04400	ACGIH TLV				
ACRYLAMIDE	79-06-1	0.05330	ACGIH TLV				
ACRYLIC ACID	79-10-7	80.00000	ACGIH TLV				
ACRYLONITRILE	107-13-1			0.40000	Massachusetts DEP	0.010000	Massachusetts DEP
ALACHLOR	15972-60-8						
ALAR	1596-84-5						
ALDICARB	116-06-3						
ALDICARB SULPONE	1646-88-4						
ALDRIN	309-00-2	0.00200	Unit Risk Factor				
ALLY	74223-64-6						
ALLYL ALCOHOL	107-18-6	66.67000	ACGIH TLV				
ALLYL CHLORIDE	107-05-1	0.53300	ACGIH TLV				
ALUMINUM	7429-90-5	133.33000	ACGIH TLV				
ALUMINUM OXIDE	1344-28-1	1.78000	ACGIH TLV				
ALUMINUM PHOSPHIDE	20859-73-8	26.67000	ACGIH TLV				
AMDRO	67485-29-4						
AMETRYN	834-12-8						
AMINO-2-METHYLANTHRAQUINONE, [1-]	82-28-0						
AMINOANTHRAQUINONE, [2-]	117-79-3						
AMINOAZOBENZENE, [4-]	60-09-3						
AMINOBIPHENYL, [4-]	92-67-1						
AMITRAZ	33089-61-1						
AMMONIA	7664-41-7			100.00000	Massachusetts DEP	100.000000	Massachusetts DEP
AMMONIUM NITRATE (SOLUTION)	6484-52-2						
AMMONIUM SULFAMATE	7773-06-0	133.33000	ACGIH TLV				
AMMONIUM SULFATE (SOLUTION)	7783-20-2						
ANILINE	62-53-3			0.20000	Massachusetts DEP	0.100000	Massachusetts DEP
ANISIDINE HYDROCHLORIDE, [ORTHO-]	134-29-2						
ANISIDINE, [ORTHO-]	90-04-0						
ANISIDINE, [PARA-]	104-94-9	6.67000	ACGIH TLV				
ANTHRACENE	120-12-7						
ANTIMONY	7440-36-0			1.00000	Missouri DOH	1.000000	Massachusetts DEP
ANTIMONY COMPOUNDS	20-00-8	6.67000	ACGIH TLV *				
APOLLO	74115-24-5						
ARSENIC (INORGANIC)	7440-38-2			0.00050	Massachusetts DEP	0.000200	Massachusetts DEP
ARSENIC COMPOUNDS (INORGANIC + ARSINE)	20-01-9	0.02670	ACGIH TLV !				
ASBESTOS	1332-21-4			0.00004	Missouri DOH	0.000004	Massachusetts DEP
ASBESTOS, AMOSITE	1332-21-4			0.00004	Missouri DOH	0.000004	Massachusetts DEP
ASBESTOS, CHRYSOTILE	1332-21-4			0.00004	Missouri DOH	0.000004	Massachusetts DEP
ASBESTOS, CROCIDOLITE	1332-21-4			0.00004	Missouri DOH	0.000004	Massachusetts DEP
ASBESTOS, OTHER FORMS	1332-21-4			0.00004	Missouri DOH	0.000004	Massachusetts DEP
ASSURE	76578-14-8						
ASULAM	3337-71-1						
ATRAZINE	1912-24-9	66.67000	ACGIH TLV				
AURAMINE	492-80-8						
AZOBENZENE	103-33-3						
BARIUM	7440-39-3	6.67000	ACGIH TLV				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
BARIUM COMPOUNDS	20-02-0	6.67000	ACGIH TLV *				
BARIUM CYANIDE	542-62-1	9.19000	ACGIH TLV *				
BAYLETON	43121-43-3						
BAYTHROID	68359-37-5						
BENEFIN	1861-40-1						
BENOMYL	17804-35-2	26.67000	ACGIH TLV				
BENTAZON	25057-89-0						
BENZ(A)ANTHRACENE	56-55-3			1.60000	Missouri DOH	0.170000	Missouri DOH
BENZAL CHLORIDE	98-87-3						
BENZALDEHYDE	100-52-7						
BENZAMIDE	55-21-0						
BENZENE	71-43-2			1.00000	Missouri DOH	0.120000	Massachusetts DEP
BENZIDINE	92-87-5	0.00010	Unit Risk Factor				
BENZO(A)PYRENE	50-32-8			0.16000	Missouri DOH	0.017000	Missouri DOH
BENZO(B)FLUORANTHENE	205-99-2			1.60000	Missouri DOH	0.170000	Missouri DOH
BENZO(K)FLUORANTHENE	207-08-9			1.60000	Missouri DOH	0.170000	Missouri DOH
BENZOIC ACID	65-85-0						
BENZOTRICHLORIDE	98-07-7						
BENZOYL CHLORIDE	98-88-4	0.88900	ACGIH TLV *				
BENZOYL PEROXIDE	94-36-0	66.67000	ACGIH TLV				
BENZYL CHLORIDE	100-44-7			14.08000	Massachusetts DEP	0.940000	Massachusetts DEP
BERYLLIUM	7440-41-7			0.00100	Massachusetts DEP	0.000400	Massachusetts DEP
BERYLLIUM COMPOUNDS	20-03-1	0.00036	ACGIH TLV *				
BIDRIN	141-66-2						
BIPHENTHRIN	82657-04-3						
BIPHENYL, [1,1-]	92-52-4			0.34000	Massachusetts DEP	0.090000	Massachusetts DEP
BIS(2-CHLORO-1-METHYLETHYL)ETHER	108-60-1						
BIS(2-ETHYLHEXYL)ADIPATE	103-23-1						
BIS(ACETATO)TETRAHYDROXYTRI-LEAD	1335-32-6			0.14000	Massachusetts DEP		
BIS(CHLOROETHYL)ETHER	111-44-4			6.90000	Missouri DNR & DOH	0.030000	Missouri DNR & DOH
BIS(CHLOROMETHYL)ETHER	542-88-1	0.00067	ACGIH TLV				
BISPHENOL A	80-05-7	66.67000	ACGIH TLV *				
BORON	7440-42-8						
BROMINE	7726-95-6			17.00000	Missouri DNR & DOH	2.900000	Missouri DNR & DOH
BROMOCHLOROMETHANE	74-97-5	14,000.00000	ACGIH TLV				
BROMODICHLOROMETHANE	75-27-4						
BROMOFORM	75-25-2	0.88900	ACGIH TLV				
BROMOMETHANE	74-83-9			5.28000	Massachusetts DEP	2.640000	Massachusetts DEP
BROMOXYNIL	1689-84-5						
BROMOXYNIL OCTANOATE	1689-99-2						
BUTADIENE, [1,3-]	106-99-0			1.20000	Massachusetts DEP	0.003000	Massachusetts DEP
BUTYL ACRYLATE	141-32-2	733.33000	ACGIH TLV				
BUTYL ALCOHOL, [N-]	71-36-3			412.24000	Massachusetts DEP	412.240000	Massachusetts DEP
BUTYL ALCOHOL, [SEC-]	78-92-2	4,066.70000	ACGIH TLV				
BUTYL ALCOHOL, [TERT-]	75-65-0	4,000.00000	ACGIH TLV				
BUTYL BENZYL PHTHALATE	85-68-7						
BUTYLATE	2008-41-5						
BUTYLENE OXIDE, [1,2-]	106-88-7						
BUTYLPHTHALYL BUTYLGLYCOLATE	85-70-1						
BUTYRALDEHYDE	123-72-8						
CADMIUM	7440-43-9			0.00600	Missouri DOH	0.001000	Massachusetts DEP
CADMIUM COMPOUNDS	20-04-2	0.00889	ACGIH TLV *				
CALCIUM CHROMATE (ANHYDROUS)	13765-19-0			0.00300	Massachusetts DEP	0.000100	Massachusetts DEP
CALCIUM CYANAMIDE	156-62-7	0.08890	ACGIH TLV				
CALCIUM CYANIDE	592-01-8	118.02000	ACGIH TLV *				
CAPROLACTAM	105-60-2	13.33000	ACGIH TLV				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
CAPTAFOL	2425-06-1	0.26700	ACGIH TLV				
CAPTAN	133-06-2	0.88900	ACGIH TLV				
CARBARYL	63-25-2	0.88900	ACGIH TLV				
CARBOFURAN	1563-66-2	1.33000	ACGIH TLV				
CARBON DISULFIDE	75-15-0			0.10000	Massachusetts DEP	0.100000	Massachusetts DEP
CARBON TETRACHLORIDE	56-23-5			3.00000	Missouri DNR & DOH	0.070000	Massachusetts DEP
CARBONYL SULFIDE	463-58-1			0.10000	Massachusetts DEP	0.100000	Massachusetts DEP
CARBOSULFAN	55285-14-8						
CARBOXIN	5234-68-4						
CATECHOL	120-80-9	3.56000	ACGIH TLV				
CHLORAL	75-87-6						
CHLORAMBEN	133-90-4			46.80000	Missouri DNR & DOH		
CHLORDANE	57-74-9			0.14000	Massachusetts DEP	0.030000	Massachusetts DEP
CHLORINE	7782-50-5			3.95000	Massachusetts DEP	3.950000	Massachusetts DEP
CHLORINE CYANIDE	506-77-4	8.00000	ACGIH TLV				
CHLORINE DIOXIDE	10049-04-4	4.00000	ACGIH TLV				
CHLOROACETIC ACID	79-11-8						
CHLOROACETOPHENONE, [2-]	532-27-4	4.00000	ACGIH TLV				
CHLOROANILINE, [PARA-]	106-47-8						
CHLOROBENZENE	108-90-7			93.88000	Massachusetts DEP	6.260000	Massachusetts DEP
CHLOROBENZILATE	510-15-6						
CHLOROFORM	67-66-3			2.40000	Missouri DNR & DOH	0.040000	Massachusetts DEP
CHLOROMETHYL METHYL ETHER	107-30-2						
CHLOROPHENOL, [2-]	95-57-8						
CHLOROPHENOLS	20-05-3						
CHLOROPRENE	126-99-8			0.98000	Massachusetts DEP	0.980000	Massachusetts DEP
CHLOROTHALONIL	1897-45-6						
CHLORPROPHAM	101-21-3						
CHLORPYRIFOS	2921-88-2	2.67000	ACGIH TLV				
CHLORSULFURON	64902-72-3						
CHROMIC ACID	7738-94-5			0.00300	Massachusetts DEP	0.000100	Massachusetts DEP
CHROMIUM	7440-47-3			1.36000	Massachusetts DEP	0.680000	Massachusetts DEP
CHROMIUM (III) COMPOUNDS	16065-83-1			0.06800	Massachusetts DEP		
CHROMIUM (VI) COMPOUNDS	18540-29-9			0.00300	Massachusetts DEP	0.000100	Massachusetts DEP
CHROMIUM COMPOUNDS	20-06-4			0.00083	Massachusetts DEP		
CHRYSENE	218-01-9			16.00000	Missouri DOH	1.700000	Missouri DOH
CI ACID BLUE 9, DIAMMONIUM SALT	2650-18-2						
CI ACID BLUE 9, DISODIUM SALT	3844-45-9						
CI ACID GREEN 3	4680-78-8						
CI BASIC GREEN 4	569-64-2						
CI BASIC RED 1	989-38-8						
CI DIRECT BLACK 38	1937-37-7						
CI DIRECT BLUE 6	2602-46-2						
CI DIRECT BROWN 95	16071-86-6						
CI DISPERSE YELLOW 3	2832-40-8						
CI FOOD RED 15	81-88-9						
CI FOOD RED 5	3761-53-3						
CI SOLVENT ORANGE 7	3118-97-6						
CI SOLVENT YELLOW 14	842-07-9						
CI SOLVENT YELLOW 3	97-56-3						
CI VAT YELLOW 4	128-66-5						
COBALT	7440-48-4	0.00889	ACGIH TLV				
COBALT COMPOUNDS	20-07-5	0.00889	ACGIH TLV *				
COKE OVEN EMMISIONS	8007-45-2	0.02670	ACGIH TLV				
COPPER	7440-50-8			5.00000	Missouri DOH	0.540000	Massachusetts DEP
COPPER COMPOUNDS	20-08-6	2.67000	ACGIH TLV *				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
COPPER CYANIDE	544-92-3	229.48000	ACGIH TLV *				
CREOSOTE	8001-58-9						
CRESIDINE, (PARA-)	120-71-8						
CRESOL, (META-)	108-39-4	293.30000	ACGIH TLV				
CRESOL, (ORTHO-)	95-48-7	293.30000	ACGIH TLV				
CRESOL, (PARA-)	106-44-5			24.05000	Massachusetts DEP	12.020000	Massachusetts DEP
CRESOLS (MIXED ISOMERS)	1319-77-3	293.30000	ACGIH TLV				
CROTONALDEHYDE	123-73-9	80.00000	ACGIH TLV				
CUMENE	98-82-8			580.00000	Missouri DOH		
CUMENE HYDROPEROXIDE	80-15-9						
CUPFERRON	135-20-6						
CYANAZINE	21725-46-2						
CYANIDE COMPOUNDS	20-09-7	66.67000	ACGIH TLV *				
CYANIDE-FREE	57-12-5	66.67000	ACGIH TLV *				
CYANOGEN	460-19-5	266.67000	ACGIH TLV				
CYANOGEN BROMIDE	506-68-3	66.67000	ACGIH TLV				
CYCLOHEXANE	110-82-7			280.82000	Massachusetts DEP	280.820000	Massachusetts DEP
CYCLOHEXANONE	108-94-1	1,333.33000	ACGIH TLV				
CYCLOHEXYLAMINE	108-91-8	533.33000	ACGIH TLV				
CYHALOTHRIN/KARATE	68085-85-8						
CYPERMETHRIN	52315-07-8						
CYROMAZINE	66215-27-8						
DACTHAL	1861-32-1						
DALAPON, SODIUM SALT	75-99-0						
DANITOL	39515-41-8						
DDE	72-55-9						
DDT (P,P'-DICHLORODIPHENYLTRICHLOROET	50-29-3	0.10000	Unit Risk Factor				
DECABROMODIPHENYL ETHER	1163-19-5						
DEMETON	8065-48-3	0.26700	ACGIH TLV				
DI(2-ETHYLHEXYL) PHTHALATE, (DEHP)	117-81-7			1.36000	Massachusetts DEP	0.770000	Massachusetts DEP
DIALLATE	2303-16-4						
DIAMINOANISOLE SULFATE, (2,4-)	39156-41-7						
DIAMINOANISOLE, (2,4-)	615-05-4						
DIAMINODIPHENYL ETHER, (4,4'-)	101-80-4						
DIAMINOTOLUENE (MIXED ISOMERS)	25376-45-8						
DIAMINOTOLUENE, (2,4-)	95-80-7						
DIAZOMETHANE	334-88-3	0.07100	ACGIH TLV				
DIBENZ(A,H)ANTHRACENE	53-70-3			0.16000	Missouri DOH	0.017000	Missouri DOH
DIBENZOFURAN	132-64-9						
DIBROMO-3-CHLOROPROPANE, (1,2-)	96-12-8						
DIBROMOBENZENE, (1,4-)	106-37-6						
DIBROMOCHLOROMETHANE	124-48-1						
DIBROMOETHANE, (1,2-)	106-93-4						
DIBUTYL PHTHALATE	84-74-2	13.33000	ACGIH TLV				
DICAMBA	1918-00-9						
DICHLOROBENZENE (MIXED ISOMERS)	25321-22-6	53.33000	ACGIH TLV *				
DICHLOROBENZENE, (1,2-)	95-50-1			81.74000	Massachusetts DEP	81.740000	Massachusetts DEP
DICHLOROBENZENE, (1,3-)	541-73-1						
DICHLOROBENZENE, (1,4-)	106-46-7			18.00000	Missouri DOH	0.180000	Massachusetts DEP
DICHLOROBENZIDENE, (3,3-)	91-94-1						
DICHLORODIFLUOROMETHANE	75-71-8	66,000.00000	ACGIH TLV				
DICHLORODIPHENYL DICHLOROETHANE, (P,P	72-54-8						
DICHLORODIPHENYL DICHLOROETHYLENE, (P,	72-55-9						
DICHLOROETHANE, (1,1-)	75-34-3	2,160.00000	ACGIH TLV				
DICHLOROETHANE, (1,2-)	107-06-2			11.01000	Massachusetts DEP	0.040000	Massachusetts DEP
DICHLOROETHYLENE, (1,1-)	75-35-4			1.08000	Massachusetts DEP	0.020000	Massachusetts DEP

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
DICHLOROETHYLENE, [1,2-]	540-59-0			215.62000	Massachusetts DEP	107.810000	Massachusetts DEP
DICHLOROETHYLENE, [TRANS-1,2-]	156-60-5	10,533.33000	ACGIH TLV				
DICHLOROMETHANE	75-09-2			20.00000	Missouri DOH	0.240000	Massachusetts DEP
DICHLOROPHENOL, [2,4-]	120-83-2						
DICHLOROPHENOXY ACETIC ACID, [2,4-]	94-75-7	1.78000	ACGIH TLV				
DICHLOROPHENOXY) BUTRIC ACID, [4-(2,4-	94-82-6						
DICHLOROPROPANE, [1,2-]	78-87-5			0.90000	Massachusetts DEP	0.050000	Massachusetts DEP
DICHLOROPROPENE, [1,3-]	542-75-6	66.67000	ACGIH TLV				
DICHLORVOS	62-73-7	0.17800	ACGIH TLV				
DICOPOL	115-32-2						
DIELDRIN	60-57-1	0.04400	ACGIH TLV				
DIEPOXYBUTANE	1464-53-5						
DIETHANOLAMINE	111-42-2			31.00000	Missouri DNR & DOH		
DIETHYL PHTHALATE	84-66-2			80.00000	Missouri DOH		
DIETHYL SULFATE	64-67-5						
DIETHYLAMINE	109-89-7			8.13000	Massachusetts DEP	4.070000	Massachusetts DEP
DIETHYLENE GLYCOL MONOBUTYL ETHER	112-34-5			450.00000	Missouri DOH		
DIFENZOQUAT	43222-48-6						
DIFLUBENZURON	35367-38-5						
DIISOPROPYL METHYLPHOSPHONATE	1445-75-6						
DIMETHIPIN	55290-64-7						
DIMETHOATE	60-51-5						
DIMETHOXYBENZIDINE, [3,3-]	119-90-4						
DIMETHYL BENZIDINE, [3,3-]	119-93-7						
DIMETHYL CARBAMOYL CHLORIDE	79-44-7						
DIMETHYL FORMAMIDE	68-12-2			6.00000	Massachusetts DEP	3.000000	Massachusetts DEP
DIMETHYL HYDRAZINE, [1,1-]	57-14-7	0.17780	ACGIH TLV				
DIMETHYL PHENOL, [2,4-]	105-67-9						
DIMETHYL PHTHALATE	131-11-3			40.00000	Missouri DOH		
DIMETHYL SULFATE	77-78-1	0.08890	ACGIH TLV				
DIMETHYL TEREPHTHALATE	120-61-6						
DIMETHYLAMINE	124-40-3			43.00000	Missouri DNR & DOH	40.000000	Missouri DNR & DOH
DIMETHYLAMINOAZOBENZENE, [4-]	60-11-7						
DIMETHYLANILINE, [N-N-]	121-69-7	333.33000	ACGIH TLV				
DIMETHYLPHENOL, [2,6-]	576-26-1						
DIMETHYLPHENOL, [3,4-]	95-65-8						
DINITRO-O-CRESOL, [4,6-]	534-52-1	2.67000	ACGIH TLV				
DINITRO-O-CYCLOHEXYL PHENOL, [4,6-]	131-89-5						
DINITROBENZENE, [META-]	99-65-0	13.33000	ACGIH TLV				
DINITROPHENOL, [2,4-]	51-28-5	2.67000	ACGIH TLV				
DINITROTOLUENE, [2,4-]	121-14-2	0.26700	ACGIH TLV				
DINITROTOLUENE, [2,6-]	606-20-2	20.00000	ACGIH TLV				
DINOSEB	88-85-7						
DIOCTYL PHTHALATE, [N-]	117-84-0						
DIOXANE, [1,4-]	123-91-1			24.49000	Massachusetts DEP	0.240000	Massachusetts DEP
DIOXINS	TPO						
DIPHENAMID	957-51-7						
DIPHENYLAMINE	122-39-4			2.72000	Massachusetts DEP	0.680000	Massachusetts DEP
DIPHENYLHYDRAZINE, [1,2-]	122-66-7	0.04500	Unit Risk Factor				
DIPHENYLMETHANE DIISOCYANATE, [4,4-]	101-68-8	2.66700	ACGIH TLV				
DIPROPYLENE GLYCOL METHYL ETHER	34590-94-8			5,500.00000	Missouri DOH		
DIPROPYLENE GLYCOL METHYL ETHER ACETAT				5,500.00000	Missouri DOH		
DIQUAT	85-00-7	1.33300	ACGIH TLV				
DISULFOTON	298-04-4	1.33000	ACGIH TLV				
DIURON	330-54-1	1.78000	ACGIH TLV				
DODINE	2439-10-3						

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
DYNACHEM (R) COPPER BRIGHTENER Z-75	TP1						
ENDOSULFAN	115-29-7	0.01780	ACGIH TLV				
ENDOTHALL	145-73-3						
ENDRIN	72-20-8	0.01780	ACGIH TLV				
EPICHLOROHYDRIN	106-89-8			8.00000	Missouri DOH	0.080000	Massachusetts DEP
EPN [ETHYL P-NITROPHENYL PHENYLPHOSPH	2104-64-5	6.67000	ACGIH TLV				
EPSILON-HEXACHLOROCYCLOHEXANE	6108-10-7	0.02000	Unit Risk Factor				
EPTC [S-ETHYL DIPROPYLTHIOCARBAMATE]	759-94-4						
ETHANOL	64-17-5			51.24000	Massachusetts DEP	51.240000	Massachusetts DEP
ETHEPHON	16672-87-0						
ETHION	563-12-2	5.33000	ACGIH TLV				
ETHOXYETHANOL, [2-]	110-80-5	253.33000	ACGIH TLV				
ETHYL ACETATE	141-78-6			391.84000	Massachusetts DEP	391.840000	Massachusetts DEP
ETHYL ACRYLATE	140-88-5			0.56000	Massachusetts DEP	0.280000	Massachusetts DEP
ETHYL BENZENE	100-41-4			360.00000	Missouri DOH	300.000000	Massachusetts DEP
ETHYL CHLORIDE	75-00-3			717.55000	Massachusetts DEP	358.780000	Massachusetts DEP
ETHYL CHLOROFORMATE	541-41-3						
ETHYL ETHER	60-29-7			329.80000	Massachusetts DEP	164.900000	Massachusetts DEP
ETHYLENE	74-85-1						
ETHYLENE GLYCOL	107-21-1			34.50000	Massachusetts DEP	34.500000	Massachusetts DEP
ETHYLENE IMINE [AZIRIDINE]	151-56-4	0.17800	ACGIH TLV				
ETHYLENE OXIDE	75-21-8			0.24300	Missouri DOH		
ETHYLENE THIOUREA	96-45-7						
ETHYLENEDIAMINE	107-15-3	333.33000	ACGIH TLV				
ETHYLPHTHALYL ETHYLGLYCOLATE	84-72-0						
EXPRESS	101200-48-0						
FENAMIPHOS	22224-92-6	1.33000	ACGIH TLV				
FLUOMETURON	2164-17-2						
FLUORIDE	16984-48-8			6.80000	Massachusetts DEP	6.800000	Massachusetts DEP
FLUORINE (SOLUBLE FLUORIDE)	7782-41-4	26.67000	ACGIH TLV				
FLURIDONE	59756-60-4						
FLUVALINATE	69409-94-5						
FOLPET	133-07-3						
FOMESAFEN	72178-02-0						
FONOFOS	944-22-9	1.33000	ACGIH TLV				
FORMALDEHYDE	50-00-0			0.80000	Missouri DOH	0.080000	Massachusetts DEP
FORMIC ACID	64-18-6	120.00000	ACGIH TLV				
FOSETYL-AL	39148-24-8						
FURAN	110-00-9			0.40000	Massachusetts DEP	0.020000	Massachusetts DEP
FURFURAL	98-01-1	106.67000	ACGIH TLV				
FURMECYCLOX	60568-05-0						
GASOLINE VAPORS	8006-61-9	12,000.00000	ACGIH TLV				
GLUFOSINATE-AMMONIUM	77182-82-2						
GLYCIDYALDEHYDE	765-34-4						
GLYCOL ETHER (ETHYLENE GLYCOL ETHERS)	20-10-0			3.00000	Massachusetts DEP	2.000000	Massachusetts DEP
GLYCOL ETHER(DIETHYLENE GLYCOL ETHERS)	20-10-0			450.00000	Missouri DOH		
GLYPHOSATE	1071-83-6						
HARMONY	79277-27-3						
HEPTACHLOR	76-44-8			0.14000	Massachusetts DEP	0.001000	Massachusetts DEP
HEPTACHLOR EPOXIDE	1024-57-3	0.00380	Unit Risk Factor				
HEXABROMOBENZENE	87-82-1						
HEXACHLOROBENZENE	118-74-1						
HEXACHLOROBUTADIENE	87-68-3	0.45000	Unit Risk Factor				
HEXACHLOROCYCLOHEXANE, [ALPHA-]	319-84-6	0.00560	Unit Risk Factor				
HEXACHLOROCYCLOHEXANE, [BETA-]	319-85-7	0.01900	Unit Risk Factor				
HEXACHLOROCYCLOHEXANE, [DELTA-]	319-86-8	0.02000	Unit Risk Factor				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
HEXACHLOROCYCLOHEXANE, [TECHNICAL]	608-73-1	0.08890	ACGIH TLV				
HEXACHLOROCYCLOPENTADIENE	77-47-4			0.00600	Massachusetts DEP	0.006000	Massachusetts DEP
HEXACHLORODIBENZO-P-DIOXIN (MIXTURE)	19408-74-3	0.00000	Unit Risk Factor				
HEXACHLOROETHANE	67-72-1			0.53000	Massachusetts DEP	0.250000	Massachusetts DEP
HEXACHLORONAPHTHALANE	1335-87-1	2.67000	ACGIH TLV				
HEXACHLOROPHENE	70-30-4						
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZIN	121-82-4						
HEXAMETHYLENE,-1,6-DIISOCYANATE	822-06-0						
HEXAMETHYLPHOSPHORAMIDE	680-31-9						
HEXANE, [N-]	110-54-3			4,200.00000	Missouri DNR & DOH	420.000000	Missouri DNR & DOH
HEXANONE, [2-]	591-78-6			10.88000	Massachusetts DEP	10.880000	Massachusetts DEP
HEXAZINONE	51235-04-2						
HYDRAZINE	302-01-2			0.00700	Massachusetts DEP	0.002000	Massachusetts DEP
HYDRAZINE SULFATE	10034-93-2						
HYDROGEN BROMIDE	10035-10-6			5.00000	Massachusetts DEP	5.000000	Massachusetts DEP
HYDROGEN CHLORIDE	7647-01-0			7.00000	Massachusetts DEP	7.000000	Massachusetts DEP
HYDROGEN CYANIDE	74-90-8			12.00000	Missouri DNR & DOH	3.000000	Missouri DNR & DOH
HYDROGEN FLUORIDE	7664-39-3			0.68000	Massachusetts DEP	0.340000	Massachusetts DEP
HYDROGEN SULFIDE	7783-06-4			0.90000	Missouri DOH	0.900000	Massachusetts DEP
HYDROQUINONE	123-31-9	26.67000	ACGIH TLV				
IMAZALIL	35554-44-0						
IMAZAQUIN	81335-37-7						
INDENO(1,2,3CD)PYRENE	193-39-5			1.60000	Missouri DOH	0.170000	Missouri DOH
IPRODIONE	36734-19-7						
ISOAMYL ACETATE	123-92-2			144.76000	Massachusetts DEP	144.760000	Massachusetts DEP
ISOBUTYL ACETATE	110-19-0			193.77000	Massachusetts DEP	193.770000	Massachusetts DEP
ISOBUTYL ALCOHOL	78-83-1			360.00000	Missouri DOH	41.220000	Massachusetts DEP
ISOBUTYRALDEHYDE	78-84-2	3,866.70000	ACGIH TLV				
ISOPHORONE	78-59-1	333.33000	ACGIH TLV				
ISOPROPALIN	33820-53-0						
ISOPROPYL ACETATE	108-21-4			283.81000	Massachusetts DEP	283.810000	Massachusetts DEP
ISOPROPYL ALCOHOL	67-63-0	13,066.70000	ACGIH TLV				
ISOXABEN	82558-50-7						
LACTOFEN	77501-63-4						
LAMINAR (R) HG DRY FILM PHOTOPOLYME	TP2						
LEAD	7439-92-1			0.35700	Missouri DOH	0.070000	Massachusetts DEP
LEAD ACETATE	301-04-2			0.00680	Massachusetts DEP		
LEAD COMPOUNDS	20-11-1	2.00000	ACGIH TLV *				
LEAD SUBACETATE	13335-32-6			0.14000	Massachusetts DEP	0.010000	Massachusetts DEP
LINDANE [GAMMA-HEXACHLOROCYCLOHEXANE]	58-89-9			0.14000	Massachusetts DEP	0.003000	Massachusetts DEP
LINURON	330-55-2						
LIQUID ALKALINE STRIP 733	TP3						
LONDAX	83055-99-6						
MACU DEP 70 A	TP4						
MACU DEP 70C	TP5						
MACU DIZER 9279 PROCESS	TP6						
MACUBLACK LT 9282	TP7						
MALATHION	121-75-5	1.78000	ACGIH TLV				
MALEIC ANHYDRIDE	108-31-6			0.27000	Massachusetts DEP	0.140000	Massachusetts DEP
MALEIC HYDRAZIDE	123-33-1						
MANEB	12427-38-2						
MANGANESE	7439-96-5	0.89000	ACGIH TLV				
MANGANESE COMPOUNDS	20-12-2	13.33000	ACGIH TLV *				
MCPP	93-65-2						
MELAMINE	108-78-1						
MEPIQUAT CHLORIDE	24307-26-4						

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
MERCURY (ELEMENTAL)	7439-97-6			0.14000	Massachusetts DEP	0.070000	Massachusetts DEP
MERCURY COMPOUNDS (ALKYL & ARYL)	20-13-3			0.00300	Massachusetts DEP	0.001400	Massachusetts DEP
MERCURY COMPOUNDS (INORGANIC)	20-13-3			0.14000	Massachusetts DEP	0.010000	Massachusetts DEP
MERPHOS	150-50-5						
MERPHOS OXIDE (BUTYL PHOSPHORO TRITHI	78-48-8						
METALAXYL	57837-19-1						
METHACRYLONITRILE	126-98-7	40.00000	ACGIH TLV				
METHAMIDOPHOS	10265-92-6						
METHANOL	67-56-1			600.00000	Missouri DOH	7.130000	Massachusetts DEP
METHIDATHION	950-37-8						
METHOMYL	16752-77-5	33.33000	ACGIH TLV				
METHOXYCHLOR	72-43-5	133.30000	ACGIH TLV				
METHOXYETHANOL, (2-)	109-86-4			3.00000	Massachusetts DEP	2.000000	Massachusetts DEP
METHYL ACRYLATE	96-33-3			9.57000	Massachusetts DEP	4.790000	Massachusetts DEP
METHYL CHLORIDE	74-87-3			105.00000	Missouri DOH		
METHYL CHLOROCARBONATE	79-22-1						
METHYL ETHYL KETONE	78-93-3			360.00000	Missouri DOH	10.000000	Massachusetts DEP
METHYL HYDRAZINE	60-34-4	0.06220	ACGIH TLV				
METHYL IODIDE	74-88-4	1.77800	ACGIH TLV				
METHYL ISOBUTYL KETONE	108-10-1			84.00000	Missouri DOH	55.700000	Massachusetts DEP
METHYL ISOCYANATE	624-83-9	0.66700	ACGIH TLV				
METHYL MERCAPTAN	74-93-1	13.33000	ACGIH TLV				
METHYL MERCURY	22967-92-6			0.00300	Massachusetts DEP	0.001400	Massachusetts DEP
METHYL METHACRYLATE	80-62-6			22.27000	Massachusetts DEP	22.270000	Massachusetts DEP
METHYL PARATHION	298-00-0	2.67000	ACGIH TLV				
METHYL TERT-BUTYL ETHER	1634-04-4						
METHYL-4-CHLOROPHENOXY) BUTYRIC ACID,	94-81-5						
METHYL-4-CHLOROPHENOXYACETIC ACID, (2-	94-74-6						
METHYLENE BIS(2-CHLOROANILINE), (4,4-)	101-14-4	0.03910	ACGIH TLV				
METHYLENE BIS(N,N-DIMETHYL)BENZENAMINE	101-61-1						
METHYLENE BROMIDE	74-95-3						
METHYLENEDIANILINE, (4,4-)	101-77-9	10.67000	ACGIH TLV				
METOLACHLOR	51218-45-2						
METRIBUZIN	21087-64-9	66.67000	ACGIH TLV				
MICHLER'S KETONE	90-94-8						
MINERAL FIBERS	TP14						
MIREX	2385-85-5						
MOLINATE	2212-67-1						
MOLYBDENUM	7439-98-7	66.67000	ACGIH TLV				
MOLYBDENUM TRIOXIDE	1313-27-5	66.67000	ACGIH TLV				
MUSTARD GAS	505-60-2						
NALED	300-76-5	40.00000	ACGIH TLV				
NAPHTHALENE	91-20-3			15.70000	Missouri DOH	14.250000	Massachusetts DEP
NAPHTHYLAMINE, (ALPHA-)	134-32-7						
NAPHTHYLAMINE, (BETA-)	91-59-8						
NICKEL	7440-02-0			0.27000	Massachusetts DEP	0.180000	Massachusetts DEP
NICKEL CARBONYL	13463-39-3	0.06200	ACGIH TLV				
NICKEL COMPOUNDS	20-14-4	1.33000	ACGIH TLV *				
NICKEL OXIDE	1313-99-1			0.27000	Massachusetts DEP	0.010000	Massachusetts DEP
NICKEL REFINERY DUST				0.04200	Missouri DOH		
NICKEL SUBSULFIDE	12035-72-2	0.02100	Unit Risk Factor				
NITRAPYRIN	1929-82-4	133.33000	ACGIH TLV				
NITRATE	14797-55-8						
NITRIC ACID	7697-37-2	66.67000	ACGIH TLV				
NITRIC OXIDE	10102-43-9	400.00000	ACGIH TLV				
NITRITE	14797-65-0						

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
NITRO-O-ANISIDINE, [5-]	99-59-2						
NITROBENZENE	98-95-3			13.69000	Massachusetts DEP	6.840000	Massachusetts DEP
NITROBIPHENYL, [4-]	92-93-3						
NITROFEN	1836-75-5						
NITROGEN DIOXIDE	10102-44-0			0.27397	NAAQS	100.000000	NAAQS
NITROGEN MUSTARD	51-75-2						
NITROGLYCERIN	55-63-0	4.00000	ACGIH TLV				
NITROPHENOL, [2-]	88-75-5						
NITROPHENOL, [4-]	100-02-7						
NITROPROPANE, [2-]	79-46-9	6.22000	ACGIH TLV				
NITROSO-DI-N-BUTYLAMINE, [N-]	924-16-3	0.00620	Unit Risk Factor				
NITROSO-N-ETHYLUREA, [N-]	759-73-9						
NITROSO-N-METHYLETHYLAMINE, [N-]	10595-95-6						
NITROSO-N-METHYLUREA, [N-]	684-93-5						
NITROSODI-N-PROPYLAMINE, [N-]	621-64-7						
NITROSODIETHANOLAMINE, [N-]	1116-54-7						
NITROSODIETHYLAMINE, [N-]	55-18-5	0.00023	Unit Risk Factor				
NITROSODIMETHYLAMINE, [N-]	62-75-9	0.00070	Unit Risk Factor				
NITROSODIPHENYLAMINE, [N-]	86-30-6						
NITROSODIPHENYLAMINE, [PARA-]	156-10-5						
NITROSOMETHYLVINYLAMINE, [N-]	4549-40-0						
NITROSOMORPHOLINE, [N-]	59-89-2						
NITROSONORNICOTINE, [N-]	16543-55-8						
NITROSOPIPERIDINE, [N-]	100-75-4						
NITROSOPYRROLIDINE, [N-]	930-55-2	0.01600	Unit Risk Factor				
NORFLURAZON	27314-13-2						
NTA [NITRILOTRIACETIC ACID]	139-13-9						
NUSTAR	85509-19-9						
OCTABROMODIPHENYL ETHER	32536-52-0						
OCTACHLORONAPTHALENE	2234-13-1	1.33000	ACGIH TLV				
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-T	2691-41-0						
OCTANE, [N-]	111-65-9	19,333.33000	ACGIH TLV				
ORYZALIN	19044-88-3						
OSMIUM TETROXIDE	20816-12-0	0.02670	ACGIH TLV				
OXADIAZON	19666-30-9						
OXAMYL	23135-22-0						
OXYFLUORFEN	42874-03-3						
PACLOBUTRAZOL	76738-62-0						
PARAQUAT	1910-42-5	0.26700	ACGIH TLV				
PARATHION	56-38-2	0.01780	ACGIH TLV				
PCB [POLYCHLORINATED BIPHENYLS]	1336-36-3			0.00300	Massachusetts DEP	0.000500	Massachusetts DEP
PENDIMETHALIN	40487-42-1						
PENTABROMODIPHENYL ETHER	32534-81-9						
PENTACHLOROBENZENE	608-93-5						
PENTACHLORONITROBENZENE	82-68-8			1.20000	Missouri DNR & DOH		
PENTACHLOROPHENOL	87-86-5			0.50000	Missouri DOH	0.010000	Massachusetts DEP
PENTANE	109-66-0	14,400.00000	ACGIH TLV				
PERMETHRIN	52645-53-1						
PEROXYACETIC ACID	79-21-0						
PHENOL	108-95-2			45.00000	Missouri DOH	9.500000	Missouri DOH
PHENYL MERCURIC ACETATE	62-38-4	0.02670	ACGIH TLV				
PHENYLENEDIAMINE, [META-]	108-45-2	0.01780	ACGIH TLV				
PHENYLENEDIAMINE, [PARA-]	106-50-3	0.01780	ACGIH TLV				
PHENYLPHENOL, [2-]	90-43-7						
PHOSALONE	2310-17-0						
PHOSGENE	75-44-5	5.33000	ACGIH TLV				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
PHOSMET	732-11-6						
PHOSPHINE	7803-51-2	5.33000	ACGIH TLV				
PHOSPHORIC ACID	7664-38-2			24.00000	Missouri DOH	0.270000	Massachusetts DEP
PHOSPHOROUS (YELLOW OR WHITE)	7723-14-0	1.33000	ACGIH TLV				
PHTHALIC ANHYDRIDE	85-44-9			1.65000	Massachusetts DEP	0.820000	Massachusetts DEP
PICLORAM	1918-02-1	1.78000	ACGIH TLV				
PICRIC ACID	88-89-1	1.33000	ACGIH TLV				
PIRIMIPHOS-METHYL	29232-93-7						
POLYCYLIC ORGANIC MATTER	TP15			0.16000	Missouri DOH	0.017000	Missouri DOH
POTASSIUM CYANIDE	151-50-8	166.86000	ACGIH TLV*				
POTASSIUM SILVER CYANIDE	506-61-6	0.24600	ACGIH TLV*				
PROCHLORAZ	67747-09-5						
PROMETON	1610-18-0						
PROMETRYN	7287-19-6						
PRONAMIDE	23950-58-5						
PROPACHLOR	1918-16-7						
PROPANE SULTONE, [1,3-]	1120-71-4						
PROPANIL	709-98-8						
PROPAZINE	139-40-2						
PROPHAM	122-42-9						
PROPICONAZOLE	60207-90-1						
PROPIOLACTONE, [BETA-]	57-57-8	0.26670	ACGIH TLV				
PROPIONALDEHYDE	123-38-6						
PROPOXUR [BAYGON]	114-26-1	6.67000	ACGIH TLV				
PROPYL ALCOHOL	71-23-8			133.63000	Massachusetts DEP	133.630000	Massachusetts DEP
PROPYLENE	115-07-1						
PROPYLENE OXIDE	75-56-9			6.00000	Massachusetts DEP	0.300000	Massachusetts DEP
PROPYLENEIMINE, [1,2-]	75-55-8	0.88900	ACGIH TLV				
PYDRIN	51630-58-1						
PYRIDINE	110-86-1	200.00000	ACGIH TLV				
QUINALPHOS	13593-03-8						
QUINOLINE	91-22-5						
QUINONE	106-51-4	0.07100	ACGIH TLV				
RADIONUCLIDES (INCLUDING RADON)	TP16						
RADIUM 226,228	7440-14-4						
RADON 222	14859-67-7						
RESMETHRIN	10453-86-8						
RESORCINOL	108-46-3			12.24000	Massachusetts DEP	3.060000	Massachusetts DEP
ROTENONE	83-79-4	0.88900	ACGIH TLV				
SACCHARIN	81-07-2						
SAFROLE	94-59-7						
SAVEY	78587-05-0						
SELENIOUS ACID	7783-00-8	4.36000	ACGIH TLV*				
SELENIUM	7782-49-2			0.54000	Massachusetts DEP	0.540000	Massachusetts DEP
SELENIUM COMPOUNDS	20-16-6			0.54000	Massachusetts DEP*		
SELENIUM SULFIDE	7446-34-6			0.54000	Massachusetts DEP	0.050000	Massachusetts DEP
SELENOUREA	630-10-4						
SETHOXYDIM	74051-80-2						
SILVER	7440-22-4	1.33000	ACGIH TLV				
SILVER COMPOUNDS	20-17-7	0.13000	ACGIH TLV*				
SILVER CYANIDE	506-64-9	0.16500	ACGIH TLV*				
SIMAZINE	122-34-9						
SODIUM ACIFLUORFEN	62476-59-9						
SODIUM AZIDE	26628-22-8	4.00000	ACGIH TLV				
SODIUM CYANIDE	143-33-9	125.58000	ACGIH TLV*				
SODIUM DIETHYLDITHIOCARBAMATE	148-18-5						

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
SODIUM HYDROXIDE (SOLUTION)	1310-73-2	26.67000	ACGIH TLV				
SODIUM SULFATE (SOLUTION)	7757-82-6						
SOLDER FLUSH 909	TP8						
STRYCHNINE	57-24-9	2.00000	ACGIH TLV				
STYRENE	100-42-5			200.00000	Missouri DOH	2.000000	Massachusetts DEP
STYRENE OXIDE	96-09-3						
SULFURIC ACID	7664-93-9			2.72000	Massachusetts DEP	2.720000	Massachusetts DEP
SUPER SOLDER STRIP 3807	TP9						
SYSTHANE	88671-89-0						
TEBUTHIURON	34014-18-1						
TEDLAR PVF FILM	TP10						
TERBACIL	5902-51-2						
TERBUTRYN	886-50-0						
TEREPHTHALIC ACID	100-21-0	1.33000	ACGIH TLV*				
TETRACHLORO-1,2-DIFLUOROETHANE, [1,1,2	76-12-0			1,133.33000	Massachusetts DEP	566.670000	Massachusetts DEP
TETRACHLOROBENZENE, [1,2,4,5-]	95-94-3						
TETRACHLORODIBENZO-P-DIOXIN, [2,3,7,8-	1746-01-6						
TETRACHLOROETHANE, [1,1,1,2-]	630-20-6						
TETRACHLOROETHANE, [1,1,2,2-]	79-34-5			18.67000	Massachusetts DEP	0.020000	Massachusetts DEP
TETRACHLOROETHYLENE	127-18-4			2.00000	Missouri DOH	0.020000	Massachusetts DEP
TETRACHLOROPHENOL, [2,3,4,6-]	58-90-2						
TETRACHLOROVINPHOS	961-11-5						
TETRAETHYL LEAD	78-00-2			0.01644	Adjusted Lead NAAQS	6.000000	Adjusted Lead NAAQS
TETRAETHYLDITHIOPYROPHOSPHATE	3689-24-5						
TETRAHYDROFURAN	109-99-9			160.35000	Massachusetts DEP	80.180000	Massachusetts DEP
THALLIC OXIDE	1314-32-5	1.49000	ACGIH TLV*				
THALLIUM	7440-28-0	1.33000	ACGIH TLV				
THALLIUM (I) SULFATE	7446-18-6	1.65000	ACGIH TLV*				
THALLIUM ACETATE	563-68-8	1.72000	ACGIH TLV*				
THALLIUM CARBONATE	6533-73-9	1.53000	ACGIH TLV*				
THALLIUM CHLORIDE	7791-12-0	1.56000	ACGIH TLV*				
THALLIUM COMPOUNDS	20-18-8	1.33000	ACGIH TLV*				
THALLIUM NITRATE	10102-45-1	1.74000	ACGIH TLV*				
THALLIUM SELENITE	12039-52-0	1.85000	ACGIH TLV*				
THERM-CHEK 6117 (BARIUM SALTS)	TP11						
THIOACETAMIDE	62-55-5						
THIOBENCARB	28249-77-6						
THIODIANILINE, [4,4'-]	139-65-1						
THIOPHANATE-METHYL	23564-05-8						
THIOUREA	62-56-6						
THIRAM	137-26-8	0.88900	ACGIH TLV				
THORIUM DIOXIDE	1314-20-1						
TITANIUM OXIDE	13463-67-7	0.88900	ACGIH TLV*				
TITANIUM TETRACHLORIDE	7550-45-0						
TOLUENE	108-88-3			400.00000	Missouri DOH	20.000000	Massachusetts DEP
TOLUENE DIISOCYANATE, [2,4-]	584-84-9			0.10000	Massachusetts DEP	0.100000	Massachusetts DEP
TOLUENE DIISOCYANATE, [2,6-]	91-08-7	0.53300	ACGIH TLV*				
TOLUIDINE HYDROCHLORIDE, [ORTHO-]	636-21-5						
TOLUIDINE, [ORTHO-]	95-53-4			2.38000	Massachusetts DEP	0.170000	Massachusetts DEP
TOXAPHENE	8001-35-2	0.08890	ACGIH TLV				
TRIALLATE	2303-17-5						
TRIAZIQUONE	68-76-8						
TRIBROMOBENZENE, [1,2,4-]	615-54-3						
TRIBUTYLTIN OXIDE	56-35-9						
TRICHLORFON	52-68-6						
TRICHLORO-1,2,2-TRIFLUOROETHANE, [1,1,	76-13-1	101,333.00000	ACGIH TLV				

Chemical	CAS #	8-HR AAL*	8-HR AAL Source	24-HR AAL*	24-HR AAL Source	Annual AAL*	Annual AAL Source
TRICHLOROBENZENE, [1,2,4-]	120-82-1	533.33000	ACGIH TLV				
TRICHLOROETHANE, [1,1,1-]	71-55-6			4,500.00000	Missouri DOH	1,038.370000	Massachusetts DEP
TRICHLOROETHANE, [1,1,2-]	79-00-5			14.84000	Massachusetts DEP	0.060000	Massachusetts DEP
TRICHLOROETHYLENE	79-01-6			64.30000	Missouri DNR & DOH	0.610000	Massachusetts DEP
TRICHLOROFLUOROMETHANE	75-69-4	995.60000	ACGIH TLV				
TRICHLOROPHENOL, [2,4,5-]	95-95-4			1.60000	Massachusetts DEP		
TRICHLOROPHENOL, [2,4,6-]	88-06-2					0.160000	Massachusetts DEP
TRICHLOROPHENOXY)PROPIONIC ACID, [2-(2	93-72-1						
TRICHLOROPHENOXYACETIC ACID, [2,4,5-]	93-76-5	1.78000	ACGIH TLV				
TRICHLOROPROPANE, [1,1,2-]	598-77-6						
TRICHLOROPROPANE, [1,2,3-]	96-18-4	4,000.00000	ACGIH TLV				
TRIDIPHANE	58138-08-2						
TRIETHYLAMINE	121-44-8			1.00000	Massachusetts DEP	0.700000	Massachusetts DEP
TRIFLURALIN	1582-09-8			73.80000	Missouri DNR & DOH		
TRIMETHYLBENZENE, [1,2,4-]	95-63-6	1,666.70000	ACGIH TLV				
TRIMETHYLPENTANE, [2,2,4-]	540-84-1			3,336.00000	Missouri DNR & DOH		
TRINITROBENZENE, [1,3,5-]	99-35-4						
TRINITROTOLUENE, [2,4,6-]	118-96-7	0.08890	ACGIH TLV				
TRIPROPYLENE GLYCOL METHYL ETHER				3,200.00000	Missouri DOH		
TRIS(2,3-DIBROMOPROPYL)PHOSPHATE	126-72-7						
TYPE 301 STAINLESS STEEL	TP12						
URANIUM (NATURAL)	7440-61-1	2.67000	ACGIH TLV				
URETHANE [ETHYL CARBAMATE]	51-79-6						
VANADIUM (FUME OR DUST)	7440-62-2			0.27000	Massachusetts DEP	0.270000	Massachusetts DEP
VANADIUM PENTOXIDE	1314-62-1			0.14000	Massachusetts DEP	0.030000	Massachusetts DEP
VERNAM	1929-77-7						
VINCLOZOLIN	50471-44-8						
VINYL ACETATE	108-05-4			30.00000	Massachusetts DEP	8.000000	Massachusetts DEP
VINYL BROMIDE	593-60-2	3.56000	ACGIH TLV				
VINYL CHLORIDE	75-01-4			3.47000	Massachusetts DEP	0.380000	Massachusetts DEP
WARFARIN	81-81-2	0.26670	ACGIH TLV				
XYLENE, [META-]	108-38-3			250.00000	Missouri DOH	11.800000	Massachusetts DEP
XYLENE, [ORTHO-]	95-47-6			250.00000	Missouri DOH	11.800000	Massachusetts DEP
XYLENE, [PARA-]	106-42-3			250.00000	Missouri DOH	11.800000	Massachusetts DEP
XYLENES (MIXED ISOMERS)	1330-20-7			250.00000	Missouri DOH	11.800000	Massachusetts DEP
XYLIDINE, [2,6-]	87-62-7	133.30000	ACGIH TLV				
ZINC (FUME OR DUST)	7440-66-6						
ZINC COMPOUNDS	20-19-9	133.33000	ACGIH TLV*				
ZINC CYANIDE	557-21-1	150.42000	ACGIH TLV*				
ZINC PHOSPHIDE	1314-84-7						
ZINC/ZINC OXIDE	1314-13-2	66.67000	ACGIH TLV				
ZINEB	12122-67-7						

Miscellaneous ARARs

MISCELLANEOUS ARARs[a]

Code of State Regulations	Revised Statutes of Missouri
10 CSR 10-2.060 10 CSR 10-2.070 10 CSR 10-2.100 10 CSR 10-6.010 10 CSR 10-6.040 10 CSR 10-6.170 10 CSR 10-6.180 10 CSR 20-6 10 CSR 20-6.200 10 CSR 20-7.015 10 CSR 20-7.031 10 CSR 23-4.010 (1) 10 CSR 23-4.4060 (4) 10 CSR 23-6.060 10 CSR 25-6.263 (2) 10 CSR 25-7.264 (2)(G)3 10 CSR 25-7.264 (2)(G)4 10 CSR 25-7.264 (2)(K) 10 CSR 25-7.264 (2)(L) 10 CSR 60-4.030 10 CSR 60-4.040 10 CSR 80-2.020 (1)(a) 10 CSR 80-2.020 (9)(a)1 10 CSR 80-2.020 (9)(a)5 10 CSR 80-2.020 (9)(b) 40 CSR Part 122	260.200(4) RSMO 260.200(34) RSMO 260.210.1(1) RSMO
	Code of Federal Regulations
	40 CFR 263 40 CFR 264.116 40 CFR 264.118 40 CFR 264.228 40 CFR 264.600 40 CFR 264.1101 40 CFR 264.1102 40 CFR 265.373-381 40 CFR 403.5
	Comprehensive Environmental Response, Compensation and Liability Act
	CERCLA 121(d)(2)A CERCLA 121(d)(3)
	Federal Regulations
	FR 47982, 48047 (Revised 40 CFR 268.40)

(a) Note that some of these notations may have been stated earlier.

APPENDIX E

RESPONSIVENESS SUMMARY

Responsiveness Summary
Remedial Action at Area 18 Operable Unit
Lake City Army Ammunition Plant, Independence, Missouri

1. Overview

The United States Army established a public comment period from April 14 to May 14, 1997 for interested parties to review and comment on remedial alternatives considered and described in the Proposed Plan for the Area Eighteen Operable (Area 18 OU). The Proposed Plan was prepared by the Army in cooperation with the U. S. Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (MDNR).

The Army also held a public meeting at 7:00 p.m. on April 22, 1997 at the Roger T. Sermon Center in Independence, Missouri to outline the proposed remedy to reduce risk and control potential hazards at the Area 18 OU.

The Responsiveness Summary provides a summary of comments and questions received from the community at the public meeting and during the public comment period as well as the Army's responses to public comments.

The Responsiveness Summary is organized into the following sections:

- Background on Community Involvement
- Summary of Comments and Questions Received During the Public Comment Period and Army Responses
- Remaining Concerns

The selected alternative for the Area 18 OU, Soil Vapor Extraction and Treatment in combination with Ground Water Extraction and Treatment, includes the following major components:

- Soil vapor extraction and treatment using a multi-phase extraction system and treatment of vapors.
- Ground water extraction and treatment.
- Institutional controls and long-term monitoring.

2. Background on Community Involvement

In August 1987, LCAAP was listed on the EPA's National Priorities List (NPL). A Federal Facilities Agreement (FFA) was signed by the Army, EPA, and the State and went into effect on

November 28, 1989. The FFA establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions for LCAAP.

Community relations activities that have taken place at LCAAP to date include:

- **FFA process** - After preparation of the FFA by the U. S. Army, EPA, and MDNR, the document was published for comment. The FFA became effective November 1989.

- **Administrative Record** - An Administrative Record for information was established in Building 3 at LCAAP. The Administrative Record contains information used to support Army decision-making. All the documents in the Administrative Record are available to the public.

- **Information repositories** - An Administrative Record outline is located at the Mid-Continent City Library, Blue Springs Branch (public repository) and at the west entrance to the Plant (Building 6).

- **Community Relations Plan (CRP)** - The CRP was prepared and has been accepted by EPA and the State of Missouri and is being implemented. This plan was updated in 1996.

- **Restoration Advisory Board (RAB)** - The RAB has been formed to facilitate public input in the cleanup and meets quarterly. In addition to Army, EPA, and Missouri oversight personnel, the RAB includes community leaders and local representatives from the surrounding area.

- **Mailing list** - A mailing list of all interested parties in the community is maintained by LCAAP and updated regularly.

- **Fact sheet** - A fact sheet describing the status of the IRP at LCAAP was last distributed to the mailing list addressees in November 1996.

- **Proposed Plan** - The Proposed Plan on this action was distributed to the mailing list addressees for their comments.

The Proposed Plan for this remedial action was distributed to the mailing list addressees for their comments, and additional copies of the Proposed Plan were available at the April 22, 1997 public meeting. A transcript of comments, questions and responses provided during the public meeting was prepared.

3. Summary of Comments and Questions Received During the Public Comment Period and Army Responses

Part I - Summary and Response to Local Community Concerns

In review of the written transcript of the public meeting, there were no community objections to the proposed remedial action indicated. No written comments were received during the public comment period.

The majority of the comments received during the public meeting were in the form of questions about the remedial investigation findings and the remedial action (i.e., what would be done, how it would be done, and what effects the action might have). Representatives of the Army were available to provide answers to the questions and also provided an overview presentation during the meeting to describe the proposed actions.

Part II - Comprehensive Response to Specific Technical, Legal and Miscellaneous Questions

There were no community objections to the proposed remedial action and there were no comments or questions from the public as a result of the April 22, 1997 public meeting.

4. Remaining Concerns

Based on review of the transcript of the oral comments received during the public meeting, there are no outstanding issues or remaining concerns associated with implementation of the proposed remedial action.