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Superfund Record of Decision:

Cimarron Mining, NM

0272-101

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Cimarron Mining site consists of two inactive ore-processing mills in Carrizozo, Lincoln County, New Mexico. Operable Unit 2 (OU2), which is the focus of this Record of Decision (ROD), addresses contamination at the 7.5-acre Sierra Blanca mill location. Land use in the area is predominantly residential, with an estimated 900 people residing within 1/2 mile north/northwest of the site. Onsite features at the Sierra Blanca location include two buildings, four discharge pits, one cinder block trench, a septic tank system, and numerous process tanks and material piles. Prior to 1970, Scott-Tex, Inc., used the site to recover a variety of metals from ores transported to the site. In the early 1970's, the mill was temporarily shut down, and ownership was transferred to the town of Carrizozo. The site was then leased and used to recover platinum and silver from ore material. In 1982, after a possible spill occurred at the Cimarron mill, milling operations were relocated to the Sierra Blanca mill. During operations, the facility discharged contaminated liquids onsite and produced approximately 570 cubic yards of contaminated material piles and other waste sludge. In 1990, EPA investigations revealed 43 cubic yards of tank sediment, 182 cubic yards of material pile soil and rock, and 345 cubic yards of discharge pit

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Cimarron Mining, NM
Second Remedial Action - Final
Contaminated Media: soil, sediment, sludge, debris
Key Contaminants: metals (arsenic, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 117
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See ANSI-Z39.18) See Instructions on Reverse OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

Abstract (Continued)

sediment and soil contaminated with high concentrations of metals, particularly lead at the Sierra Blanca location. A 1990 ROD addressed contamination of the original Cimarron mill, as OU1. This ROD addresses the final remedial action of the soil and waste piles at the Sierra Blanca mill location, as OU2. The primary contaminants of concern affecting the soil, sediment, debris, and sludge are metals including arsenic and lead.

The selected remedial action for the site includes excavating and treating onsite 225 cubic yards of contaminated material piles and tank sediment, including cinder block trench sediment which failed the TCLP test, using cement solidification and stabilization; excavating and disposing of 345 cubic yards of contaminated surficial soil and sludge that did not fail the TCLP test in an onsite discharge pit along with the solidified/stabilized waste; capping the discharge pit with an impermeable cover; removing all process drums, and decontaminating tanks and associated piping onsite; filling in the discharge pits and the cinder block trench with onsite soil and covering with clean fill; installing additional ground water monitoring wells; monitoring ground water; and implementing institutional controls including deed restrictions, and site access restrictions including fencing and zoning ordinances. The estimated present worth cost for this remedial action is $79,000, which includes a total present worth O&M cost of $10,000.

<u>PERFORMANCE STANDARDS OR GOALS</u>: Chemical- and action-specific soil clean-up goals for lead are based on the "Interim Guidance on Establishing Soil Lead Clean-up Levels at Superfund Sites", and remediation levels will not exceed lead 500 mg/kg.

Decision Summary
Cimarron Mining Corporation Site
Operable Unit 2 (Sierra Blanca)
Record of Decision

September 1991

DECLARATION FOR THE RECORD OF DECISION
CIMARRON MINING CORPORATION SITE
OPERABLE UNIT 2 (SIERRA BLANCA)
CARRIZOZO, NEW MEXICO

Statutory Preference for Treatment as a Principal Element is Met and Five-Year Review is Not Required

SITE NAME AND LOCATION

Cimarron Mining Operable Unit 2 (Sierra Blanca)
Carrizozo, Lincoln County, New Mexico

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the final operable unit of the Cimarron Mining Corporation site in Carrizozo, Lincoln County, New Mexico, which was chosen 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 upon the contents of the administrative record file for the Cimarron Mining Corporation site.

The United States Environmental Protection Agency and the New Mexico Environment Department (NMED) agree on the selected remedy.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE SELECTED REMEDY

This final remedy addresses remediation of soil and waste pile contamination at the Cimarron Mining Corporation Operable Unit 2 (Sierra Blanca) mill location. The principal threats posed by the site will be eliminated or reduced through treatment and engineering controls.

The major components of the selected remedy include:

o Solidification/stabilization of contaminated soils and waste piles exceeding 500 ppm lead and onsite disposal.

o Ground Water Monitoring

- Install two additional ground water monitoring wells.

- The ground water sampling program, to be developed in the Operation and Maintenance Plan, may be amended and/or eliminated if data confirms effective remediation of the site has occurred.

In addition to the soils and waste pile remedy, the following measures will be implemented:

o Removal of the process chemical drums, and decontamination of tanks and associated piping;

o Filling in the discharge pits and cinder block trench with onsite soils and covering with clean fill;

o Inspection and maintenance of the existing fence.

STATUTORY DETERMINATIONS

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

Because this remedy will not result in hazardous substances remaining onsite above health-based levels, a five-year review of the remedial action is not required.

Robert E. Layton Jr.
Robert E. Layton Jr., P.E.
Regional Administrator
U.S. EPA - Region 6

9/6/91
Date

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Decision Summary
Cimarron Mining Corporation Site
Operable Unit 2
Record of Decision

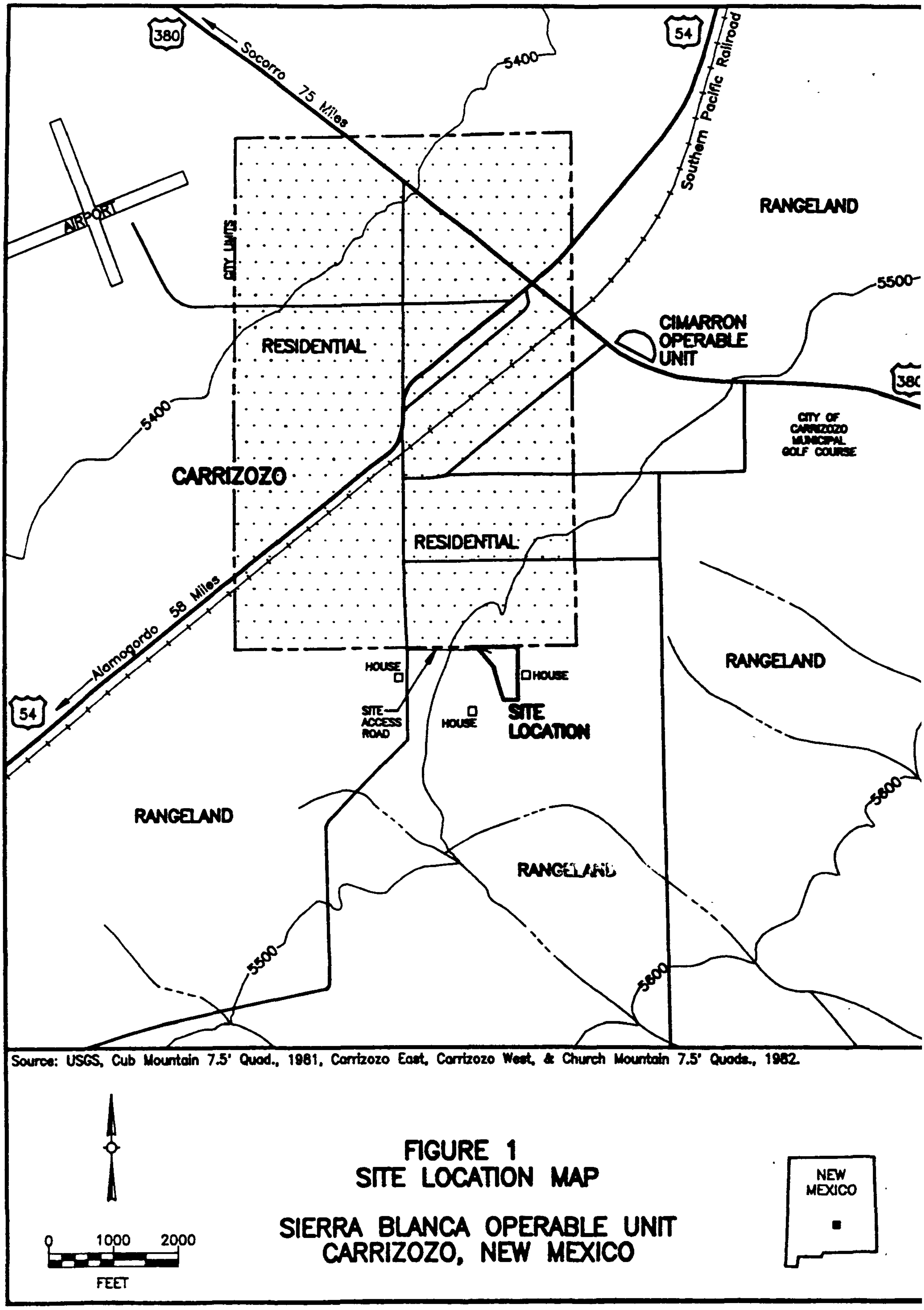
I. LOCATION AND GENERAL DESCRIPTION

The Sierra Blanca milling location near Carrizozo, New Mexico, has been identified as an Operable Unit (OU) 2 of the Cimarron Mining Corporation Superfund site as a result of contamination of soils with arsenic and metals. The facility, which is no longer operating, utilized precious metal extraction processes which resulted in unpermitted discharge of contaminated liquids, and the stockpiling of approximately 570 cubic yards of contaminated materials piles and other waste sediment. Ground water is not contaminated and no surface water exists near the site. The site is 7.5 acres in size, relatively flat, and is located in T8S, R10E, Section 11, east of U.S. Highway 54 (Figure 1). Figure 1 shows the location of both mill sites (i.e. Operable Unit 1 and Operable Unit 2), and their relative positions to each other and the town of Carrizozo, which has a population of approximately 900. One resident is located directly adjacent to the site and the primary residential population is approximately 1/2 mile north/north-west of the site. Access to Sierra Blanca is restricted by a barbed-wire fence and locked gates.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Sierra Blanca Facility is an inactive mill originally owned by Scott-Tex, Inc., and used to recover a variety of metals from ores transported to the site. The mill temporarily shut down in the early 1970's, and the Town of Carrizozo eventually became owner of the site. In 1979, the site was leased under the name of "American Minerals Recovery Corporation." Notes acquired from the laboratory in the main on-site processing building indicate that the facility operators were attempting to recover silver from various ore materials. It has been reported that the operators claimed that platinum was also recovered from the ore material. An New Mexico Environment Department (NMED) site inspection report prepared on 11/18/80 states that "this operation extracts whatever there is a market for - one week gold, the next silver, platinum and so on."

The Sierra Blanca mill was designed and operated similarly to the Cimarron mill with the exception that cyanide was apparently not used at Sierra Blanca. For a short period of time, the two mills were apparently operated concurrently and by the same people. EPA and NMED site file information discusses a possible spill at Cimarron which prompted milling operations to be relocated to Sierra Blanca in June of 1982.



Source: USGS, Cub Mountain 7.5' Quad., 1981, Carrizozo East, Carrizozo West, & Church Mountain 7.5' Quads., 1982.

FIGURE 1
SITE LOCATION MAP

SIERRA BLANCA OPERABLE UNIT
CARRIZOZO, NEW MEXICO

The Sierra Blanca milling location includes two buildings, four discharge pits, one cinder block trench, a septic tank system, and numerous process tanks and materials piles.

A 1975 U.S. Soil Conservation Service aerial photograph (USDA, SCS, 1983) shows that the site included only a single building (Process Building 1), and no discharge pits and only a few materials piles in 1975. Sometime between 1980 and 1984, discharge pits, process tanks, and more materials piles were added.

An NMED memo dated March 6, 1980, states that there were two buildings at the site, each owned by a different individual. According to the memo, the southern building (Process Building 1) was owned by Sierra Blanca Mining and Processing Co. and housed operations consisting of mechanical separation of gold from its natural ore. The ore material was reportedly from the Jicarilla Mountain area in south-central New Mexico. The southern building (Process Building 2) was owned by Double Eagle Mining Co., which planned to chemically extract gold from ore. The memo indicates that this ore was transferred from the Cimarron site. The memo states that Double Eagle Mining Co. maintained extraction equipment both inside and outside of the northern building.

A February 1985, NMED Site Inspection Report described the site as an "abandoned ore-processing mill with 2 lined impoundments, an underground storage tank, 2 above ground tanks and a small unlined pit." The lining in the impoundments was noted to be torn. The actual on-site inspections were performed in April, May, and June, 1984. Subsequent investigations performed by CDM-FPC under contract to EPA have resulted in the identification of contaminated materials above health based levels.

It should be noted that portions of the facility have been dismantled, sold, moved, and/or removed. The current site features are shown on Figure 2. The material pile locations and outlines are approximate.

The extensive RI field work and feasibility study began in May 1990 and was completed in June 1991. The data generated was used to estimate the extent and magnitude of contamination at the Cimarron Mining site and to develop and review remedial alternatives. The alternatives evaluated included various treatment alternatives for the soils and waste piles, institutional controls, and no action.

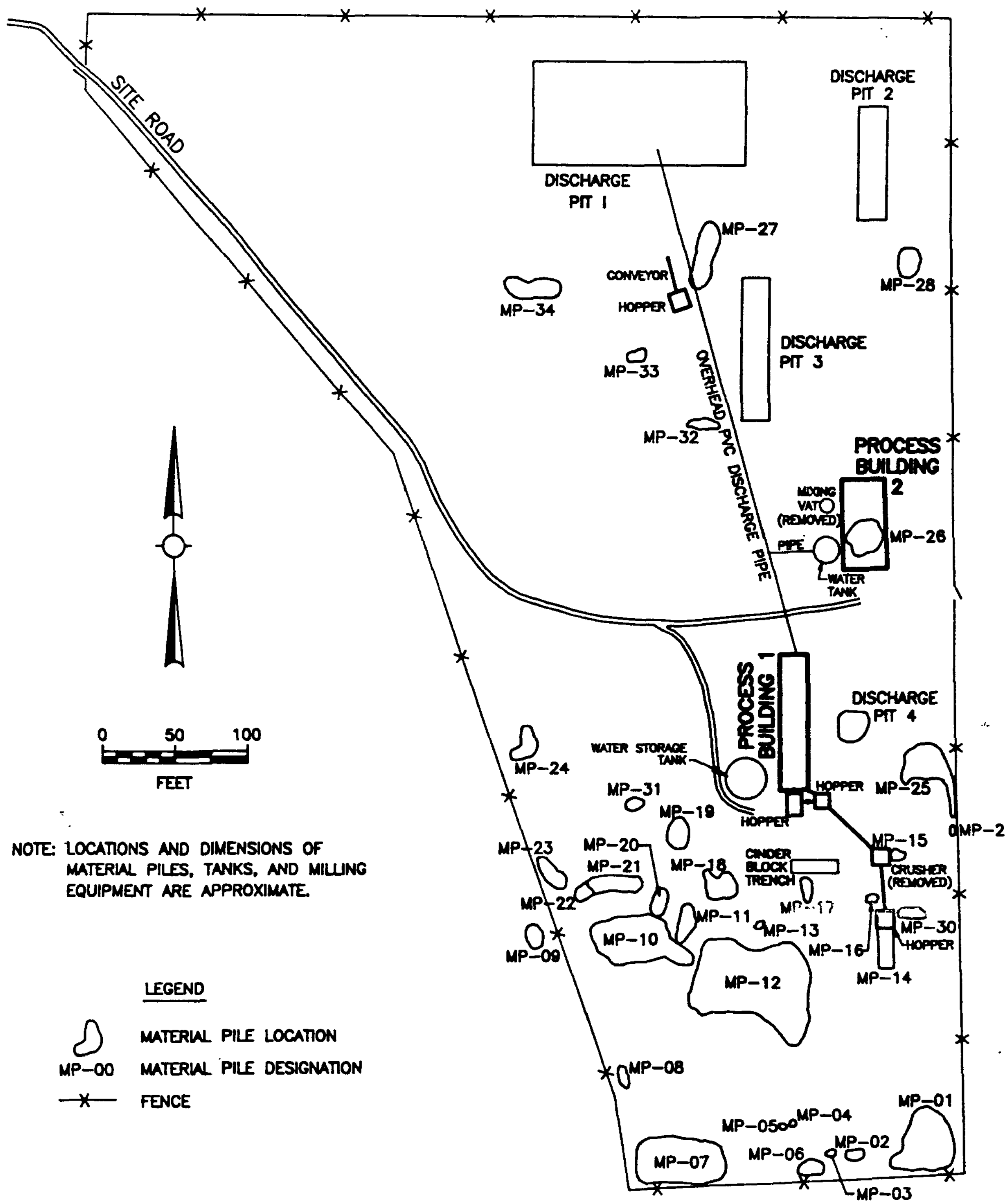


FIGURE 2

SITE MAP

III. COMMUNITY PARTICIPATION

Community interest in the Cimarron Mining site has been relatively high due to the close proximity of the site to the town of Carrizozo.

Major community interest has focused on alleviating the stigma of a hazardous waste or Superfund site as it relates to the community and the desire to have an expeditious solution to allow future industrial development of the site.

A public "open house" workshop was conducted in May 1989 to inform the community of the general RI/FS activities planned and the Superfund process and to answer any questions. Approximately 35 people attended, including out-of-town individuals and representatives of the local newspaper and the New Mexico Bureau of Mines.

Questions and comments ranged from concerns regarding the level of site contamination, potential impacts on the community and possible solutions to a disregard for the previous analytical data from the site and an unwillingness to accept the potential of long term impacts from the site contamination.

In March 1990, a second public workshop, primarily for Cimarron Operable Unit 1, was conducted to notify the community of the preliminary RI results and to answer questions. Approximately 25 people attended this workshop. Most questions evolved around potential remedial solutions and the schedule of future activities. A major portion of the meeting involved discussions of the Cimarron Operable Unit 2 (Sierra Blanca) site and the responsible party status of the town of Carrizozo, which leased the property to the operators of the mill.

Numerous informal status briefings have been conducted with various interested citizens and local officials including presentations, by invitation, at the local chapter of the Rotary Club.

The public participation requirements of CERCLA sections 113(K)(2)(B)(i-v) and 117 have been met. The RI/FS documents for the Cimarron Mining Operable Unit 2 (Sierra Blanca) site and a Proposed Plan of Remedial Action were released for public comment in June 1991. Public notices were published in the Lincoln County News, fact sheets were mailed to interested individuals, and the documents were made available for review in local repositories. A public meeting to discuss the Proposed Plan was conducted on June 17, 1991.

Approximately 15 people attended the public meeting. Most comments (from 2 commentors) on the proposed plan of solidification/stabilization and onsite disposal focused on the potential for off site disposal of the treated soils. No comments were presented which adamantly opposed the solidification and on site disposal alternative. Officials representing the Town of Carrizozo also had no comment regarding the proposed remedy.

The responsiveness summary presented on page 21 provides further details regarding the comments received at the public meeting. No additional comments were received during the 30 day public comment period, which ended on July 10, 1991.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT

The Cimarron Operable Unit 2 (Sierra Blanca) RI/FS has been performed in accordance with EPA's National Contingency Plan under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), and the Superfund Amendments Reauthorization Act (SARA). This will be the final operable unit for this site.

The overall objectives of the RI/FS are:

- o To collect and evaluate data to determine the extent of surficial contamination at the site.
- o To collect and evaluate data to determine if subsurface contamination has occurred in either the soils or ground water.
- o To collect and evaluate data to characterize the shallow subsurface geology and hydrogeology.
- o To determine if ground water from nearby residential wells has been affected by site activities.
- o To evaluate human health and environmental risks posed by site-related contamination identified during the RI.
- o To identify potentially applicable or relevant and appropriate regulations (ARARs) for response actions.
- o To identify and evaluate remedial alternatives to address human health and/or environmental risks.

Based on the evaluation of the milling process, findings of previous investigations, and results of the RI field investigation, the sources and the areas of environmental contamination at the Sierra Blanca site have been delineated.

The remedy outlined in this Record of Decision represents the final remedial action at the site and will address the principal threats which are posed by the lead contaminated soils and materials piles.

V. SITE CHARACTERISTICS

In contrast to the Cimarron site, the Sierra Blanca property is not contaminated with cyanide. At Sierra Blanca, the ground water has been found to be unaffected by past site operations; but some soils, tank sediments, discharge pit sediments, and waste pile soils contain high concentrations of various metals, particularly lead. Typical background concentrations of lead in the area average approximately 13 ppm (parts per million), whereas onsite concentrations range as high as 46,400 ppm.

EPA has issued a directive establishing interim soil cleanup levels of 500-1000 ppm lead at Superfund sites (OSWER Directive #9355.4-02, EPA, 1989). These levels represent safe onsite levels assuming either a residential or industrial future use, respectively. EPA has established 500 ppm as the most appropriate soil level for this site. This is a conservative level in that it assumes future residential use of the property.

Figure 3 depicts the areas of the Sierra Blanca property which are contaminated with lead concentrations above 500 ppm. Other metals besides lead are also found at elevated concentrations at the site. These elements are arsenic, barium, beryllium, copper, lead, manganese, mercury, silver, and zinc. Lead, however, represents the most significant threat to human health, and therefore lead is considered the principal threat at the site. The cleanup of these other compounds will be incidental to the lead cleanup.

Based on the results of the RI, approximately 43 cubic yards of tank sediments, 182 cubic yards of material pile soils and rock, and 345 cubic yards of discharge pit sediment and site soils are contaminated with lead at levels above 500 ppm.

Referring to Figure 3, for the tank samples analyzed for lead, the maximum on-site lead concentration is 46,400.0 ppm. Seven tanks (TS-01-TS-07) contained lead at concentrations above 500 ppm. The average concentration of lead in all tanks sampled is 12,049 ppm.

Lead in the various waste piles on site has a maximum concentration of 18,900.0 ppm. The contaminated waste piles are MP-01, MP-02, MP-03, MP-26, and MP-32. In contrast to the

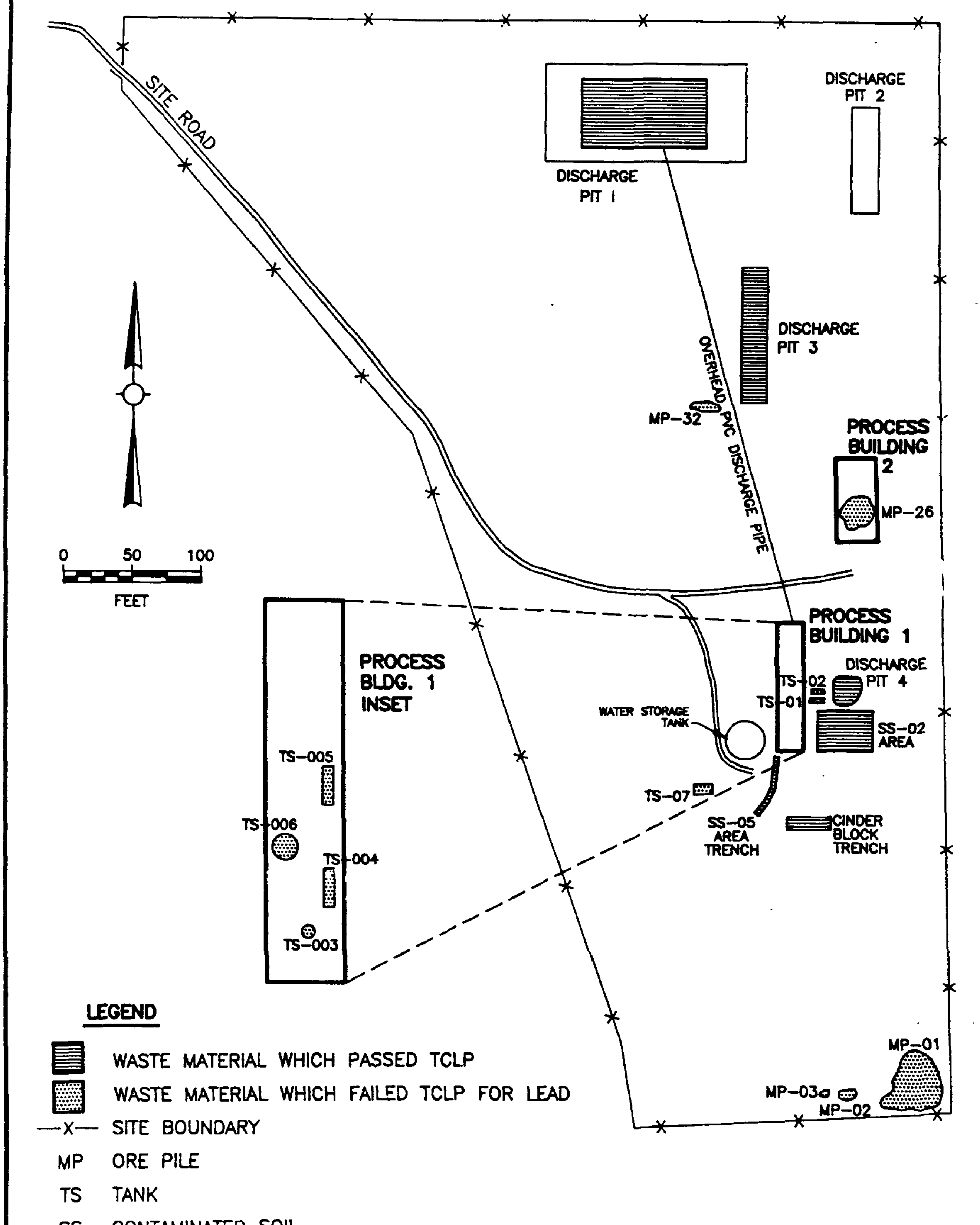


FIGURE 3

ESTIMATED EXTENT OF AREAS WITH LEAD CONCENTRATIONS GREATER THAN 500 PPM tank sediments, where the majority of samples indicate high elevated concentrations of lead, only four of the 34 waste pile samples analyzed indicate contamination with lead at levels in excess of the 500-1000 ppm guidance levels. Two piles, MP-01 and MP-26, with lead concentrations of 18,900 ppm and 18,700 ppm, respectively, are the only piles that demonstrate significantly elevated lead levels. All other waste pile samples contain lead at concentrations of 114 ppm or less.

The maximum level of lead in surface soils at the site is 10,409 ppm, with an overall average concentration of 1470 ppm. Although surface soil and waste pile samples collected at the site indicate highly elevated concentrations of lead in some areas, the contamination has been found to be limited to 6" to 18" in depth. The contaminated soils areas are shown in Figure 2 as SS-02 and SS-05.

It is important to note that the various types of contaminated material at the site differ in physical characteristics. The materials vary considerably with respect to particle size.

The tank sediments, discharge pit sediments, and site soils consist of fine particle size soils, whereas the material in the material piles ranges in size from soil particles to boulder size rocks. The materials also vary with respect to their leaching potential.

As part of the sampling program, select samples were analyzed using Toxicity Characteristic Leaching Procedure (TCLP) for the elements of concern: arsenic, barium and lead. The TCLP analysis is a procedure for evaluating a material's ability to release contaminants to the environment. The samples were chosen to be representative of contaminated tank sediments, surface soils, material piles, and discharge pit sediments. Only the samples of tank sediments and material piles failed the TCLP test for lead. All of the samples passed the TCLP test for arsenic and barium.

This indicates that the metals present in soils and discharge pit sediments are tightly bound within the soil and that migration of arsenic and the metals of concern from discharge pit sediments and contaminated surface soils to deeper soils and groundwater is not likely to occur. However, lead in the material piles 1, 2, 3, 26, and 32, as indicated in Figure 4, does have the potential for such migration via leaching. If tanks were spilled or dispersed on the ground, lead migration could also occur.

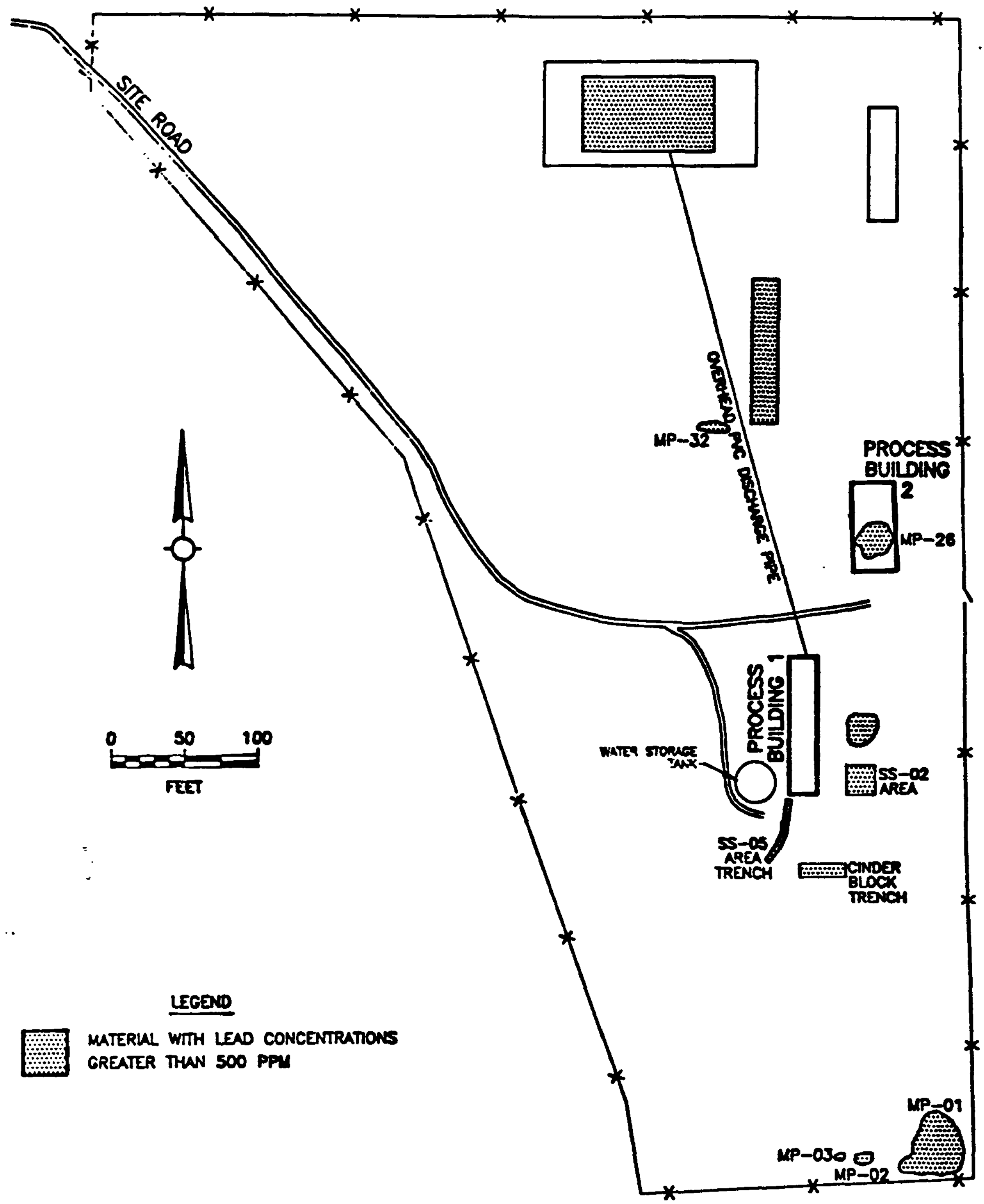


FIGURE 4

ESTIMATED AREAL EXTENT OF ELEVATED METALS CONCENTRATIONS IN SURFACE SOILS, DISCHARGE PIT SEDIMENTS, & MATERIAL PILES

With respect to the remedial action at Sierra Blanca, the TCLP results help to direct the cleanup. Those materials which fail the TCLP test will have to undergo more stringent treatment to control potential migration of contaminants than those materials which pass the test. In accordance with EPA Publication 9347.3-12FS dated January 1991, titled "Superfund Guide to RCRA Management Requirements for Mineral Processing Wastes," mineral processing waste is subject to hazardous waste regulations under RCRA Subtitle C if it meets the definition of a RCRA hazardous waste (i.e. a listed waste or exhibits a characteristic, as in failing the TCLP test).

Alternative remedial approaches to the Sierra Blanca waste materials are further discussed below in this Decision Summary and in the Feasibility Study for Sierra Blanca.

VI. SUMMARY OF SITE RISKS

The objective of the Risk Assessment was to determine whether or not the substances present at the Sierra Blanca site present potential human health risks. Risks were evaluated by incorporating Sierra Blanca, or Operable Unit 2 (OU2) contaminant concentration data into tables previously developed for the risk assessment portion of the Cimarron (OU1) RI/FS. This data table is used due to the similarity of contaminants and the geographical proximity of the two sites. Media evaluated included surface soil, material piles, discharge pit and tank sediments, and ground water. The Risk Assessment evaluated the potential cancer and noncancer health risks associated with incidental ingestion of soils from the site, dermal contact with soils from the site, and inhalation of windblown dust containing site-related contaminants. Groundwater is not evaluated since the groundwater has been found to not be contaminated with site related contaminants of concern.

Baseline Risk

Due to the lack of an accepted oral reference dose (Rfd) for lead, the primary contaminant of concern at Sierra Blanca, it is difficult to quantify the current baseline risks. However, any exposure to elevated concentrations of lead can potentially result in elevated blood lead levels, particularly in children.

At the present time there are no final regulatory standards for lead in soils. As previously stated, EPA has issued a directive establishing interim soil lead cleanup levels of 500-1000 ppm at Superfund sites (OSWER Directive #9355.4-02, EPA, 1989). These levels represent safe onsite levels based on acceptable inhalation/ingestion risks, assuming either a residential or industrial future use, respectively. EPA has established 500 ppm as the most appropriate soil level for this site. This is a conservative level in that it assumes future residential use of the property.

EPA currently suggests the use of a computer model, referred to as the Uptake Biokinetic Model, for helping to verify or refine cleanup goals. This model was used taking into consideration all potential sources (air, soil, water, etc.) of lead exposure with regards to site specific aspects of the Sierra Blanca mill and the Carrizozo area, for generating a safe level. The results of this modeling (Attachment 1) indicate that a 500 ppm lead cleanup level is safe and appropriate.

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

Exposure Assessment

A degree of conservatism is built into the risk calculations in several areas. First, all exposures evaluated are for a hypothetical future on-site population. Assumptions in the exposure evaluation include residential development on the contaminated site, 30 years of residence at that location, and that every day during that period is spent on the site. As described in the OU1 RI report the evaluation of surface soils assumes that soil to which ingestion or dermal exposure occurs contains all site-related contaminants at the maximum level detected in surface soils. Because contaminant concentrations vary at different locations at the site and exposure to maximal concentrations for all contaminants by one individual is unlikely, this overestimates any combination of exposures that could actually occur at the site and maximizes the risk estimates generated by the risk calculations. This approach is regarded by EPA as sufficient to characterize risks in this level of analysis. If such as evaluation indicates that contaminants from the site do not present an appreciable health risk, even under these "worst case" exposure assumptions, it can be assumed that exposures associated with more plausible exposure scenarios are also without appreciable risks. Tables 1, 2, and 3 present the calculations and parameters used to estimate ingestion, dermal absorption, and inhalation exposures in this assessment.

TABLE 1

RISKS FROM INGESTION OF COMPOUNDS IN SOIL

$$\text{Lifetime Cancer Risk} = \left[\begin{array}{c}\text{Lifetime Average}\\ \text{Daily Exposure}\end{array}\right] \times [\text{Cancer Potency Factor}]$$

$$= \left[\frac{CS \times IR \times CF \times FI \times EF \times ED}{BW_l \times AT}\right] \times [CPF]$$

$$\text{Hazard Index} = [\text{Daily Exposure}] \div [\text{Reference Dose}]$$

$$= \left[\frac{CS \times IR \times CF \times FI}{BW_T}\right] \div [RfD]$$

where:

CS	=	concentration of chemical in soil (mg/kg) - compound specific
IR	=	ingestion rate (mg soil/day) = 200 for child; = 100 for adult
CF	=	conversion factor (10^{-6} kg/mg)
FI	=	fraction ingested from contaminated source = 100%
EF	=	exposure frequency (days/yr) = 1, current; = 365, future
ED	=	exposure duration (years) = 1, current; = 30, future
AT	=	averaging time (days) = 25,550
BW_l	=	average lifetime bodyweight (kg) = 70 kg
BW_T	=	bodyweight at time of exposure (kg) = 15 kg (child)
CPF	=	cancer potency factor $(mg/kg\text{-}d)^{-1}$ - compound specific
RfD	=	reference dose (mg/kg-d) - compound specific

Toxicity Assessment

The Hazard Quotient (HQ) approach to evaluation of potential health risks assumes that there is a level of exposure below which it is unlikely for even sensitive populations to experience adverse health effects. If the HQ exceeds unity (1), there may be concern for potential systemic effects. As a rule, the greater the HQ above unity the greater the level of concern. To assess the overall potential for noncancer effects posed by exposure to multiple chemicals, a Hazard Index (HI) approach has been developed based on EPA's "Guidelines for Health Risk Assessment of Chemical Mixtures". This approach assumes that simultaneous subthreshold exposures to several chemicals could result in an adverse health effect. The HI is equal to the sum of the HQs. When the HI exceeds unity, there may be concern for potential health effects. It should be noted that not all substances present on the site act on the same target organ or produce the same adverse health effect. Therefore, summation or the HQs to generate a HI is a conservative estimate of risk.

A review of the data indicates that the contaminants of concern (COCs) at Sierra Blanca are similar in surface soils, materials piles, and tank sediments. The major COC is lead; however, arsenic and other metals are present in conjunction with lead at various locations on the site. The elements evaluted in the risk assessment are arsenic, barium, beryllium, copper, lead, manganese, mercury, silver, sodium and zinc. COCs include all of these, with the addition of sodium. Tank sediment COCs include all those found in soil, with the exception of beryllium. COCs in ground water consist of lead, manganese, and zinc. Table 4 shows all substances detected and indicates which substances were found at elevated levels, by media. The Reference Doses (RfDs) available for COCs at Sierra Blanca are listed in Table 5. The Reference Doses (Rfds) for the COCs at this site exist only for evaluation of ingestion exposures. No RfD values are currently available for evaluation of inhalation or dermal exposures to these COCs. As in the risk assessment for OU1, oral RfDs are used to evaluate potential health risks following dermal absorption of substances. This approach assumes that systemic toxicity is similar following absorption via the skin or gastrointestinal tract. This approach was not used for inhalation exposures in the OU1 assessment or in this report, as toxicity via this route is frequently specific to the respiratory tract.

Two of the COCs (arsenic and beryllium) are identified as known or suspected human carcinogens. These are listed in

TABLE 2

RISKS FROM
DERMAL CONTACT WITH CHEMICALS IN SOIL

$$\text{Lifetime Cancer Risk} = \left[\begin{matrix}\text{Lifetime Average}\\ \text{Absorbed Dose}\end{matrix}\right] \times [\text{Cancer Potency Factor}]$$

$$= \left[\frac{CS \times CF \times SA \times LR \times ABS \times EF \times ED}{BW_1 \times AT}\right] \times [CPF]$$

$$\text{Hazard Index} = [\text{Daily Absorbed Dose}] \div [RfD]$$

$$= \left[\frac{CS \times CF \times SA \times LR \times ABS}{BW_T}\right] \div [RfD]$$

here:

CS = concentration of chemical in soil (mg/kg) - compound specific

CF = conversion factor (10^{-6} kg/mg).

SA = surface area of skin available for contact (cm^2/event) = 2,100 cm^2 child; = 5,300 cm^2 adult

LR = loading rate of soil on skin (mg/cm^2) = 0.5 mg/cm^2

ABS = absorption fraction (unitless) = 1%

EF = exposure frequency (events/year) = 1/yr for current scenario; = 260 ages 1-5 (5 times/wk), 104 thereafter (2 times/wk) for future.

ED = exposure duration (years) = 1 current; = 30 future

BW_l = average lifetime body weight (kg) = 70 kg

BW_T = bodyweight at time of exposure (kg) = 70 kg adult; = 15 kg child

AT = averaging time (days) = 25,550

CPF = cancer potency factor $(mg/kg\text{-}d)^{-1}$ - compound specific

RfD = reference dose (mg/kg-d) - compound specific

TABLE 3

RISKS FROM
INHALATION OF DUSTS

$$\text{Lifetime Cancer Risk} = \left[\begin{array}{c}\text{Lifetime Average}\\ \text{Daily Exposure}\end{array}\right] \times [\text{Unit Risk Factor}]$$

$$= \left[\frac{CD \times CF_1 \times CF_2 \times RD \times ED \times WF}{AT}\right] \times [URF]$$

where:

CD	=	concentration of contaminant in dust (mg/kg) - compound specifi
CF_1	=	conversion factor #1 (10^3 $\mu g/mg$)
CF_2	=	conversion factor #2 (10^{-9} $kg/\mu g$)
RD	=	concentration of respirable dust in air ($\mu g/m^3$) = 12 $\mu g/m^3$
ED	=	exposure duration (years) = 30 years
WF	=	fraction of time wind blows toward receptor (unitless) = 10%, current; = 100%, future
AT	=	averaging time (years) = 70 years
URF	=	unit risk factor $(\mu g/m^3)^{-1}$ - compound specific

TABLE 4

METALS DETECTED AT ELEVATED CONCENTRATIONS, BY MEDIA*

Compound	Soil**	Material Piles	Tank Sediments
arsenic	X	X	X
barium	X	X	X
beryllium	X		X
copper	X	X	X
lead	X	X	X
manganese	X	X	X
mercury	X	X	
silver	X	X	X
sodium			X
zinc	X	X	X

*X indicates that the substance was present at an elevated concentration onsite. Only those compounds detected at elevated concentrations were included in the human health risk assessment.

**Including discharge pit sediments.

Table 6 together with their carcinogenic slope factors (CSFs) for oral or inhalation exposures. Both of these compounds are considered to be carcinogenic following either ingestion or inhalation expsoures.

Ecological Assement

In addition to human helath evaluations, environmental impacts of the site were evaluated. No endangered species were identified on or near the Sierra Blanca site. The primary opportunity for ecological exposures is through contaminated soils which may be incidentally ingested by animals during feeding or may be in contact with plant roots. High concentrations of lead at Sierra Blanca, and associated elevated concentrations of other constituents such as arsenic and barium, are not dispersed across the site, but rather are present in distinct and separable locations on-site. Contaminated materials are found in discharge pit sediments, material piles, tank sediments, and two well defined small areas of surface soils.

The remedial action to be conducted at Sierra Blanca will entail treatment and disposal of the contaminated material in such a way that the material will no longer be available for contact by humans or animals. Since the contaminated material is only located in the above specific areas of the sie, rather than scattered across the site as is the case at many Superfund sites, a remedial action directed at those specific contaminated areas will effectively remove ecological threats as well as human health risks. Analyses performed based on available data indicate that using the 500 ppm lead soil cleanup level ensures no significant ecological threats at the Sierra Blanca Mill.

Risk Assessment Summary

As stated previously, the risk calculations performed in this review are conservative. Maxiumum concentrations of contaminants are used in all but the inhalation exposure calculations, even though the maximum concentrations do not occur in the same sample locations. Additional conservatism is added by the summation of the Hazard Quotients due to the fact that not all of the COCs may act on the same target organ or produce the same adverse health effect. Additionally, only the exposures by hypothetical future on-site resident population are used in calculating the HQ and carcinogenicity of each contaminant. This hypothetical population is expected to endure the highest exposure to site-related contaminants, and so experience the greatest health risks.

Arsenic and beryllium are evaluated for carcinogenicity following inhalation exposure to surface soil. The summed lifetime cancer risk is 1.0E-06, with individual cancer risk of 1.0E-06 and 2.5E-08 for arsenic and beryllium, respectively. Generally, a carcinogenic risk value of 1.0E-04 to 1.0E-07 is within the range of target risk levels EPA has identified as acceptable in the NCP.

Calculations of surface soil ingestion exposure show a summed HI of 3.2E+00 with the highest HQ of 1.4E+00 presented by barium. As mentioned earlier, only arsenic and beryllium are evaluated for lifetime cancer risk following ingestion exposure. Lifetime cancer risk for these constituents folllowing surface soil ingestion is calculated as 9.3E-04. Material pile soil ingestion exposure calculations reveal a summed HI of 4.3E+00, with HQs of 1.0E+00 and 2.3E+00 for barium and manganese, respectively. Evaluation of material pile soil ingestion predicts a lifetime cancer risk of 7.7E-05. Calculations regarding ingestion exposure to tank sediments show individual HQs of 3.01E+00 and 4.4E+00 for barium and silver, respectively. Tank sediment evaluation reveal an ingestion lifetime cancer risk of 9.7E-07. Site ground water has been found not be contaminated with contaminants of concern.

Using the future scenario, there are no increased systemic risks via dermal exposure from any COC in any media. None of the summed HIs or individual HQs for dermal exposure are above one. Evaluation of surface soil dermal exposure reveals a lifetime cancer risk of 6.1E-05. Evaluation of material pile dermal exposure show arsenic to present a lifetime cancer risk of 4.7E-06. Tank sediment dermal exposure calculations reveal a lifetime cancer risk of 5.1E-08 for a single exposure.

It should be noted that lifetime cancer risk calculations for surface soil ingestion and dermal exposure are performed using the maximum concentration of arsenic of 731 mg/kg. This concentration is an order of magnitude higher than the next highest sample of 79.6 mg/kg or the arithmetic average concentration of arsenic in surface soil of 50.5 mg/kg. Cancer risks associated with these lower concentrations would be nearly one order of magnitude lower. Additionally, it should be noted that numerous issues relevant to the evaluation of arsenic carcinogenicity, particularly following arsenic ingestion, have been reviewed and include nonlinearities in the dose-response curve for arsenic carcinogenicity which could reduce the risk posed by a given dose. In combination with the lower concentrations of arsenic found at most locations on the site, actual risk or cancer

TABLE 5

ORAL REFERENCE DOSES FOR CONTAMINANTS OF CONCERN

Compound	RfD - oral (mg/kg-d)	Uncertainty Factor	Modifying Factor	Toxicity Endpoint	Reference
arsenic	pending				IRIS
barium	7.0E-02	3	1	blood pressure	IRIS
beryllium (sol salt)	5.0E-03	100	1	none	IRIS
copper	3.7E-02	NA	NA	GI irritation	HEAST
lead	NA				
manganese	1.0E-01	1	1	CNS effects	IRIS
mercury	3.0E-04	1000	1	kidney effects	HEAST
silver	3.0E-03	2	1	grey coloration of the skin	IRIS
sodium	NA				
zinc	2.0E-01	10	1	anemia	HEAST

NA = not available

TABLE 6

CARCINOGENIC SLOPE FACTORS FOR CONTAMINANTS OF CONCERN

	---INHALATION---		---INGESTION---		
Compound	CSF (mg/kg-d)-1	Unit Risk (ug/m3)-1	CSF (mg/kg-d)-1	Unit Risk (ug/l)-1	Classification
arsenic	5.0E+01	4.3E-03	1.8E+00	5.0E-05	Group A
beryllium (sol salt)	8.4E+00	2.4E-03	4.3E+00	1.2E-04	Group B2

could be lower than the values presented in the attached tables by up to two orders of magnitude. Table 7 summarizes the HIs and total cancer risk for each exposure pathway and media of concern.

VII. DESCRIPTION OF ALTERNATIVES

Numerous remedial alternatives were screened during the feasibility study process including reprocessing/recycling, soil washing, thermal treatment, biological treatment, off site disposal in mine shafts, etc. The screening process eliminated those alternatives which were not technically feasible, could not meet State and/or Federal regulations, or would not be protective of public health and the environment.

Subsequent to this detailed screening process, a total of five alternatives for the Sierra Blanca site remediation were analyzed in detail. The following alternatives were evaluated using the nine selection criteria outlined on page 27 of this Decision Summary. The details of this evaluation are contained in Chapters 8, 9, and 10 of the Feasibility Study report (Attachment 2).

1. No Action
2. Institutional Controls
3. Cement Solidification/stabilization and On-Site Disposal
4. Cement Solidification/stabilization and Off-Site Municipal Landfill Disposal
5. Off-Site Municipal Landfill and Hazardous Waste Landfill Disposal

ALTERNATIVE 1 - NO ACTION

The No Action alternative (consisting of monitoring only) provides a baseline for reviewing other remedial alternatives for the Sierra Blanca site. Because no remedial activities would be implemented to mitigate contamination present at the site under this alternative, it is possible that people could be exposed to contaminants. With the exception of the removal of the process chemical drums and tank sediments onsite, no reduction in risks to human health and the environment would occur.

Capital costs are $17,000 and as with all alternatives evaluated, include installing 2 additional ground water monitoring wells at the site. Annual operation and maintenance (O & M) costs include semi-annual ground water sampling and analysis for metals for a period of 30 years. Present worth of O & M costs is estimated to be $48,000.

TABLE 7

SUMMARY OF RISKS ASSOCIATED WITH POTENTIAL FUTURE EXPOSURE

Future Scenario	Summed Hazard Index	Maximum Hazard Quotient	Compound	Total Cancer Risk	Primary Contributor to Risk
SOIL INGESTION					
Lifetime - Surface Soil	3.2E+00	1.4E+00	barium	9.3E-04	arsenic
Lifetime - Material Piles	4.3E+00	2.3E+00	manganese	7.2E-05	arsenic
From Tanks	--	4.4E+00	silver	9.7E-07	arsenic
DERMAL ABSORPTION FROM SOIL					
Lifetime - Surface Soil	1.7E-01	7.2E-02	barium	6.1E-05	arsenic
Lifetime - Material Piles	2.3E-01	1.2E-01	manganese	4.7E-06	arsenic
From Tanks	--	2.3E-01	silver	5.1E-08	arsenic
DUST INHALATION					
Onsite Residence	--	--	--	1.0E-06	arsenic

ALTERNATIVE 2 - INSTITUTIONAL CONTROLS

Under this alternative, no active remedial measures to directly address contamination at the site would be implemented; rather, legal controls, such as site access and land use restrictions, would be used to minimize the likelihood of contact with contamination. Monitoring of ground water as described for Alternative 1 is included under Alternative 2 to ensure that the risks to human health are being addressed. Institutional control measures that could be implemented consist of fencing, land use restrictions or deed notices, and zoning ordinances which would limit activities on the site. These additional measures will also be selectively included as elements of the other remedial alternatives.

The use of institutional control measures provide a greater degree of protection of human health than the No Action alternative, however, this alternative will not address the potential for contaminant migration from the site. Also, long term effectiveness would likely be low due to difficulties in enforcement.

Additionally, this alternative provides no reduction in the toxicity, mobility, or volume of contaminants at the site as suggested by the Superfund law.

Annual costs associated with this remedial action are attributed to ground water monitoring costs. Total estimated present worth cost of this alternative is $93,000.

ALTERNATIVE 3: CEMENT SOLIDIFICATION/STABILIZATION AND ON-SITE DISPOSAL

EPA's Preferred Alternative

Alternative 3 entails treatment of contaminated waste material that can leach, followed by onsite disposal of all wastes. Treatment would be accomplished by a fixation process using Portland cement to stabilize the waste material. The 225 cubic yards of waste which failed the TCLP tests (and can leach) are the material piles and the tank sediments, including cinder block trench sediments. Contaminated surficial soils and soils within the discharge pits passed the TCLP tests but remain a health risk due to other potential exposure routes. This non-leachable fraction will also be disposed of in the onsite discharge pit.

Implementation of Alternative 3 would consist of leasing a standard portable concrete mixer and setting it up on the site. Portland cement of a type to be determined based on bench scale tests would be purchased and stockpiled on-site, together with any supplemental sand or aggregate required to achieve the mix design.

The contaminated material piles would be excavated and discharged into the cement mixer, where the material would be mixed with Portland cement, water, and any supplemental sand or aggregate required. The resulting concrete mixture would then be transported to the discharge pit and deposited. Non-leachable contaminated surficial soils and sediments within the contaminated discharge pits would be excavated and disposed directly without treatment. An impermeable cover, the specifications of which will be determined in the design phase, will be incorporated to restrict the infiltration of precipitation. The discharge pit would then be covered with clean soils. Two additional monitoring wells will also be installed as an extra precautionary measure to ensure protection of the ground water.

Alternative 3 would be highly protective of human health and the environment, as the wastes would be treated to prevent leaching. Additionally, this alternative would achieve compliance with all State and Federal regulations. A high degree of long-term effectiveness and permanence would be achieved since the waste's mobility would be significantly reduced. Due to the known reliability of the stabilization treatment method for the contaminated material, it is anticipated that monitoring can be significantly reduced compared to Alternative 1 and 2, therefore, monitoring costs have been reduced accordingly. Alternative 3 is readily implementable with an estimated present worth cost of $79,000.

ALTERNATIVE 4: CEMENT SOLIDIFICATION/STABILIZATION AND OFF-SITE MUNICIPAL LANDFILL DISPOSAL

Alternative 4 also involves cement solidification/fixation treatment of the leachable portion of the Sierra Blanca waste material, followed by transportation together with excavated non-leachable wastes to a suitable off-site municipal landfill for final disposal. This alternative is similar to Alternative 3, except that final disposal of the wastes would be in an off-site landfill. Transportation of the wastes would be accomplished in standard public highway-approved bulk carrier trucks, of approximately 40,000 lb. capacity, which would be covered to control dust.

Alternative 4 would reduce the mobility of the wastes through treatment. Implementation of this alternative would provide a reasonable degree of short-term effectiveness, provided appropriate precautions and control measures such as dust control are instituted during the remediation phase.

As with Alternative 3, Alternative 4 would be highly protective of human health and the environment since the wastes would be treated. The estimated present worth cost of Alternative 4 is $235,000.

ALTERNATIVE 5: OFF-SITE MUNICIPAL AND HAZARDOUS WASTE LANDFILL DISPOSAL

In lieu of treatment of the leachable portion of the Sierra Blanca waste material, an alternate approach would be to dispose of it in an off-site hazardous waste landfill. Alternative 5, therefore, consists of excavating the leachable wastes and transporting them without treatment to a suitable hazardous waste landfill. Because there is no requirement to dispose of the non-leachable wastes in a hazardous waste landfill, these wastes would be excavated, kept segregated from the leachable wastes, and transported to a municipal landfill for final disposal.

Although Alternative 5 would be protective of human health and the environment, the degree of protectiveness would be less than the alternatives involving treatment. Compliance with State and Federal regulations would be achieved as disposal of the wastes in permitted municipal and hazardous waste landfills is allowed under current regulations. Off site disposal without treatment however, is the least preferred remedial action under the Superfund Amendments and Reauthorization Act. The estimated present worth cost of this alternative is $344,000.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Figure 3 shows the areas of highest lead contamination (in excess of 500 ppm). Treatment of these soils and waste piles would effectively address the principal threats due to lead contamination, potential ingestion/inhalation impacts and potential migration to ground water. Accordingly, remedial action alternatives for the site focus on removal of those areas of soil contamination and waste piles above 500 ppm lead, with some continued ground water monitoring to ensure long-term effectiveness.

Potential remedial action alternative technologies were evaluated to address soil and waste pile contamination at the Cimarron Mining Operable Unit 2 (Sierra Blanca) site. This evaluation was performed by progressing through the series of analyses which are outlined in the National Contingency Plan, (NCP), in particular, 40 CFR Section 300, along with various guidance documents issued by the EPA, Office of Solid Waste and Emergency Response (OSWER). This process addresses the Superfund Amendments and Reauthorization Act (SARA) Section 121 requirements of selecting a remedial action that is protective of human health and the environment, that is cost-effective, that at least meets Federal and State requirements that are applicable or relevant and appropriate, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Additionally, SARA Section 121 and the guidance documents referenced above require EPA to give preference to remedies which employ treatment which permanently and significantly reduces the mobility, toxicity, or volume of hazardous substance as their principal element. The details of this evaluation are contained in Chapters 8,9, 10 of the Feasibility Study report (Attachment 2).

Alternate technologies were identified using best engineering judgement following the guidelines presented in Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988), Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites (EPA, 1988), and the Handbook for Remedial Action at Waste Disposal Sites (EPA, 1988).

The initial step in determining the appropriate remedial action for the Cimarron Mining Operable Unit 2 (Sierra Blanca) site was to identify suitable remediation technologies. A review and analysis of the available remediation methods was conducted and feasible alternatives were developed.

The detailed evaluation process is a structured format, designed to provide relevant information needed to adequately compare and evaluate feasible alternatives to allow selection of an appropriate remedy for the site by EPA through the Record of Decision (ROD) process. The remedy must meet the following statutory requirements:

- Be protective of human health and the environment;
- Attain ARARs (or provide ground for invoking a waiver):
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element, or provide an explanation in the ROD as to why it does not.

Nine evaluation criteria have been developed to address the statutory requirements listed above and to address additional technical and policy considerations that have proven to be important for selecting remedial alternatives. These criteria are listed and briefly described below:

- Overall Protection of Human Health and the Environment - How well the alternative reduces risks to human health and the environment, through treatment, engineering or institutional controls.

- Compliance with ARARs - How well the alternative complies with all applicable or relevant and appropriate requirements or, if a waiver is required, how it is justified.

- Long-Term Effectiveness and Permanence - How well the alternative maintains long-term effectiveness in protection of human health and the environment. Alternatives which afford the highest degree of long-term effectiveness and permanence are those that leave little or no untreated waste at the site.

- Reduction of Toxicity, Mobility or Volume through Treatment - Anticipate performance of the specific treatment technologies that an alternative may employ and their ability to destroy or irreversibly treat contaminants.

- Short-Term Effectiveness - How well the alternative protects human health and the environment during construction and implementation of a remedy.

- Implementability - Whether the alternative is technically and administratively feasible and whether the required goods and services are available.

- Cost - Analysis of capital and O & M costs of each alternative to determine cost-effective remedies. Cost estimates are developed with relative accuracy (-30% to +50%) and are presented as present worth costs so that alternatives can be reasonably compared.

- State Acceptance - To be completed for the most part after the public comment period; this criterion describes the preferences of the State or support agency.

- Community Acceptance - To be completed for the most part after the public comment period; this criterion reflects the preferences of the community.

Below, each of the five alternatives for Cimarron Mining Operable Unit 2 (Sierra Blanca) soil and waste pile contamination is individually evaluated and then comparatively analyzed on the basis of the first seven of the nine criteria above. The last two criteria above (State and community acceptance) were fully addressed after the public comment period, the results of which are stated in the Responsiveness Summary on page 34 of this Decision Summary.

Alternative 1

Alternative 1, No Action, is implementable; however, it provides no treatment, engineering, or institutional measures to control the exposure of receptors to contaminated material. No reduction in risks to human health and the environment would occur, therefore this alternative would not be in compliance with ARARS.

No controls for exposure, other than the existing fence, and no long-term or short-term site management are included under Alternative 1. This alternative provides no reduction in the toxicity, mobility, or volume of the contaminated ores, tank sediments, and surficial soils on the site. All existing and potential future risks associated with the site would remain. With respect to ground water, no effects from site contaminants have been detected. With respect to soils, quantifiable risks are present which consist of hazards arising from potential exposure to lead, with limited additional effects from other metals.

Alternative 2

The use of institutional control measures, Alternative 2, provides a greater degree of protection of human health than the No Action alternative alone, since institutional action can reduce the potential exposure of receptors. Access and land use restrictions further limit activities on the property which would minimize exposure risks. While some degree of human health protectiveness would be provided by Alternative 2, it would not be protective of the environment since the contamination will remain.

Like Alternative 1, Alternative 2 would not comply with ARARs due to requirements imposed by RCRA Subtitles C and D regarding disposal of mining wastes, and due to New Mexico solid waste regulations. Although reduction in the potential for human exposure would be recognized under this alternative, only limited long-term effectiveness would be provided due to difficulties in enforcement of the institutional control measures. Additionally, this alternative provides no reduction in the toxicity, mobility, or volume of contaminants at the site.

Alternative 3

Alternative 3, stabilization and on-site disposal, would be highly protective of human health and the environment, as the wastes would be treated to the extent practicable. Additionally, this alternative would achieve compliance with all ARARs. A high degree of long-term effectiveness and permanence would be achieved. Stabilization is the state-of-the-art technology for immobilizing metals and has been utilized effectively for many years. Durability tests are being conducted on the solidified material as part of the bench scale treatability tests. This information will be utilized in determining the necessary optimum mixture ratios to ensure the long term effectiveness of this option.

Alternative 3 would reduce the toxicity and mobility of the wastes through treatment; however, the volume of the wastes would not be reduced as a result of cement solidification fixation treatment. Implementation of this alternative should provide a reasonable degree of short-term effectiveness, provided appropriate precautions and dust control measures are instituted during the remediation phase. These measures would be those that minimize or prevent exposure hazards to on-site workers and adjacent residents during remediation activities.

Implementation of this alternative is possible without undue technical or administrative difficulty.

Alternative 4

As with Alternative 3, Alternative 4, stabilization and off-site municipal landfill disposal, would be highly protective of human health and the environment since the wastes would be treated, and compliance with ARARs would be achieved. The degree of long-term effectiveness and permanence would be comparable to on-site landfill disposal, since a municipal landfill in compliance with current regulations is monitored closely.

Alternative 4 would reduce the toxicity and mobility of the wastes through treatment. The volume of wastes would, however, be substantially increased as a result of treatment, which would impact transportation costs.

Implementation of this alternative should provide a reasonable degree of short-term effectiveness, provided appropriate precautions and dust control measures are instituted during the remediation phase. These measures would be those that minimize or prevent exposure hazards to on-site workers and nearby residents during remediation activities. Implementation would be dependant on acceptance of the material by the off-site facility.

Alternative 5

Alternative 5 off-site municipal and hazardous waste landfill disposal, would be moderately protective of human health and the environment, although the degree of protectiveness would be less than the alternatives involving treatment. Compliance with ARARs would be achieved as disposal of the wastes in permitted municipal and hazardous waste landfills is allowed under current regulations. A similar degree of long-term effectiveness and permanence would be provided with this alternative as compared to on-site landfill disposal. Although treatment would be provided prior to disposal in an on-site landfill, the continuous monitoring and active waste management present in a permitted hazardous waste landfill should provide a comparable level of protectiveness. The long-term effectiveness and permanence of off-site hazardous waste landfill disposal would be less than treatment and disposal in a municipal landfill, since treatment of the wastes would be provided prior to disposal in the municipal landfill. Additionally, the level of waste management and waste monitoring provided is comparable at both facilities.

Alternative 5 would reduce the mobility of the wastes as a result of disposal in a hazardous waste landfill. However, the toxicity and volume of the wastes would not be affected.

Implementation of this alternative should provide a reasonable degree of short-term effectiveness, provided the appropriate precautions and dust control measures are instituted during the remediation phase involving excavation of the contaminated material.

Implementation of this alternative would be dependent on acceptance by the off-site facilities. Off site disposal without treatment however, is the least preferred remedial action under the Superfund Amendments and Reauthorization Act.

Cost Comparison

1.	No Action	$48,000
2.	Institutional Controls	93,000
3.	Cement Solidification/Onsite Disposal	79,000
4.	Cement Solidification/Offsite Municipal Landfill Disposal	235,000
5.	Off-site Municipal and Hazardous Waste Landfill Disposal	344,000

IX. SELECTED REMEDY

EPA's selected remedy (Alternative 3) - cement solidification/stabilization and on site disposal has been reviewed and concurred with by the New Mexico Environment Department. The proposed alternative, along with the other detailed alternatives, was evaluated and ranked according to the nine selection criteria outlined above. This ensured a comprehensive and thorough study of the benefits of each alternative. This alternative was found to be the most cost-effective and protective of the alternatives studied.

Alternative 3 - Cement Solidification/stabilization and On-site Disposal

Also includes:

- removal of process chemical drums and tanks
- install two additional monitoring wells, long term monitoring of the ground water
- deed notice of remediation activities
- installation of an impermeable cover/cap for the disposal area

Final Remediation Goal

Medium	Chemical	Point of Compliance	Remediation Goal
Soils	Lead	On Site Surface Soils	500 ppm

X. STATUTORY DETERMINATION

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

Stabilization of the soil and waste pile material exceeding 500 ppm would provide protection of human health and the environment by reducing the mobility of the lead in the soils and its potential for contaminating groundwater. Treatment will also ensure that the waste is not a significant ingestion or inhalation risk. Hazard Indices for noncarcinogens at the site will be less than 1 upon completion of remedial action.

Additionally, implementation of the selected remedy will not pose unacceptable short-term risks or cross-media impacts. The selected remedy also meets the statutory requirement to utilize permanent solutions and treatment technologies to the maximum extent practicable.

The long-term risks associated with the Sierra Blanca soils and waste piles contamination would be minimized. Short-term risks could be addressed by ensuring that airborne dusts are controlled during implementation of the remedy. The selected remedy could be readily implemented, since no special technologies would be required; and the remedy utilizes typical construction techniques.

All Federal and State requirements for this remedy that are Applicable or Relevant and Appropriate (ARARs) can be met through adequate design and planning.

Long-term effectiveness is achieved through solidification and stabilization of the contaminants of concern. In addition, treatment is utilized to the maximum extent practicable in this alternative.

This remedy is cost effective in comparison to other alternatives. The total cost of the selected remedy is estimated to be $79,000 net present worth dollars (+50% or -30%). Five-year facility reviews will not be necessary for the soils since contaminants above health based levels will not remain. Ground water monitoring will continue for 30 years if sample analysis deems it necessary.

The selected remedy provides the best balance of tradeoffs among the selection criteria used to evaluate the five proposed alternatives for the site, as discussed in this Record of Decision.

Community and state acceptance is favorable to this remedy in comparison to other alternatives presented during the public comment period.

XI. DOCUMENTATION OF NO SIGNIFICANT CHANGES

The Proposed Plan for the Cimarron Mining Operable Unit 2 (Sierra Blanca) site was released for puubliccomment in June 1990. The Proposed Plan identified Alternative 3, solidification/stabilization and onsite disposal, as the preferred alternative. EPA reviewed all comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.

XII. RESPONSIVENESS SUMMARY

Community Preferences

Based upon the responses received during the public meeting, it appears that the Citizens of Carrizozo, and town officials have preference for the selected remedy of solidification/ stabilization and onsite disposal. Only one citizen commented at the public meeting regarding the potential for off site disposal and no comments were received from town officials. No additional comments were received during the 30 day public comment period, which ended on July 10, 1991. The New Mexico Environment Department has provided formal concurrence with the proposed remedy.

Integration of Comments

1. Comment: Could soils available on site be used as a neutralizing agent and mixed with the lead contaminated materials to reduce the leaching potential?

   Response: No. Athough the soils onsite do provide some neutralizing capacity, the quantity of soil necessary to render the contaminated material non hazardous would be much greater than the cement required for the proposed solidification remedy. Due to the resulting increase in quantity of material to be handled and increased monitoring requirements, soil neutralization would not be as cost effective nor as protective as the proposed stabilization remedy.

2. Comment: Are two additional ground water monitoring wells necessary?

   Response: Yes. Based on the studies conducted at the site, EPA and NMED concluded that two additional ground water monitoring wells and continued monitoring are necessary to ensure protection of the local ground water resources.

3. Comment: Is the solidification/stabilization of lead contaminated soils an EPA accepted process?

   Response: Yes. The solidification/stabilization of metals contaminated soils is the state-of-the-art technology for immobilizing such contaminants. The technology is successful for treating contaminated soils with much higher lead concentrations than those found at "Sierra Blanca". Treatability studies were conducted during the Feasibility Study to determine optimum cement/soil mixture ratios and leaching tests indicated the process is highly effective.

4. Comment: Why is solidification/stabilization and offsite disposal not considered a better remedy?

   Response: Superfund law requires remedies to be cost effective and also directs EPA to give preference to on site remedies. Disposal off site would be approximately three times the cost due to the extremely high transportation costs and disposal fees, with no increase in protectiveness, over on site disposal.

5. Comment: Is the proposed clean-up level of 500 parts per million lead safe for the residents of Carrizozo?

   Response: Yes. This clean up standard presumes that after remediation the site will be lived upon by families with children (who are most sensitive to chronic lead poisoning). It is EPA's best current scientific judgement that resulting soil lead levels less than 500 ppm are safe for human beings.

   EPA utilized a computer model, referred to as the Uptake Biokinetic Model, for helping to verify or refine cleanup goals. This model was used taking into consideration all potential sources (air, soil, water, etc.) of lead exposure with regards to site specific aspects of the Sierra Blanca mill and the Carrizozo area, for generating a safe cleanup level. The results of this modeling indicate that a 500 ppm lead cleanup level is safe and appropriate.

6. Comment: In a layman's perspective, how many car batteries would it take to cause the level of lead contamination found at "Sierra Blanca"?

   Response: The lead at this site did not originate from batteries. A logical comparison can not be made between the lead in car batteries and the minute particles of lead found in the approximately 570 cubic yards of contaminated soils and tank sediments at the Sierra Blanca site.

   The severity of lead contamination is based on a potential for inhalation and ingestion of lead, with 500 parts per million lead being the health based cleanup criteria. Lead concentrations at Sierra Blanca range as high as 46,400 parts per million, or more simply stated, approximately 100 times the acceptable health based limit.

Attachment 1

Integrated Uptake/Biokenetic Modeling

Since there are no USEPA-approved RfD values for lead, it is not possible to evaluate the noncancer risks of lead by calculation of an hazard index. An alternative approach is to estimate the likely effect of lead exposure on the concentration of lead in the blood (PbB). Several mathematical models have been developed for calculating the value of PbB as a function of environmental concentrations of lead. Of these, the EPA's Integrated Uptake/Biokinetic (IUBK) model called LEAD4 has the greatest flexibility and has been most thoroughly validated, so it was selected for use here.

LEAD4 is a lead uptake biokinetic model which could be used as an alternative to calculating Hazard Quotient for lead. LEAD4 estimates the likely effect of lead exposure based on the concentration of lead in the blood of children between the ages of 0-84 months. The model was used to evaluate the effect of surface soil ingestion on blood lead levels in children ages 0-84 months for the Sierra Blanca site assuming a residential scenario. The model LEAD4 is limited to children and can't be used for adults due to large biological differences.

It is commonly agreed that young children are more susceptible to the effects of lead than older children or adults. This is based on three facts: 1) young children tend to have higher exposure levels (especially to soil), 2) young children have higher lead absorption rates, and 3) the nervous system of infants and young children is more sensitive to the neurological effects of lead. It should be noted that some parameters of the model cannot be adjusted to approximate adult exposure, i.e., ingestion rate, other parameters including specific body compartments could not be adjusted to the adult representative sizes. Therefore, the risk to adults from exposure to lead could not be calculated using the model. However, we might cautiously assume that concentrations protective to children (sensitive population), might be protective to adults.

The model was applied on data from the site and Carrizozo the area. The percentage of the child population that would exceed the critical cutoff point of 10 ug/dL blood level was 21.38 based on average lead concentrations on site (Figure 1). The percentage could increase to 99.99 if the lead exposure concentration is based on the highest lead concentrations in onsite materials (Figure 2). A value of less than or equal to 5% is generally considered acceptable. That is 5% of the population will have a chance of exceeding the cutoff blood lead concentration of 10 ug/dL. For the Sierra Blanca site, a soil concentration of 500 mg/kg will achieve less than the 5% value (see Figure 3).

EPA believes that actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or, the environment.

Figure 1

Input Value: Soil/Dust Lead Concentration = 1470 ppm

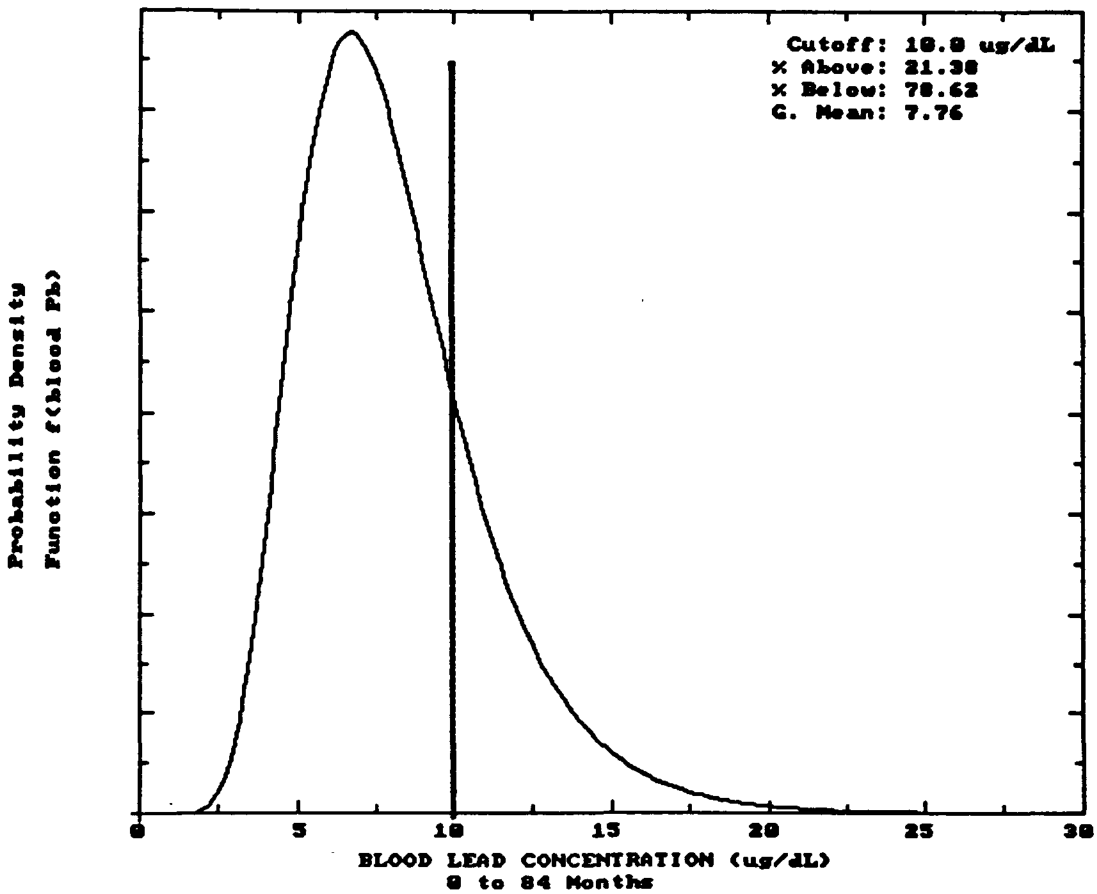


Figure 2

Input Value: Soil/Dust Lead Concentration = 18,900 ppm

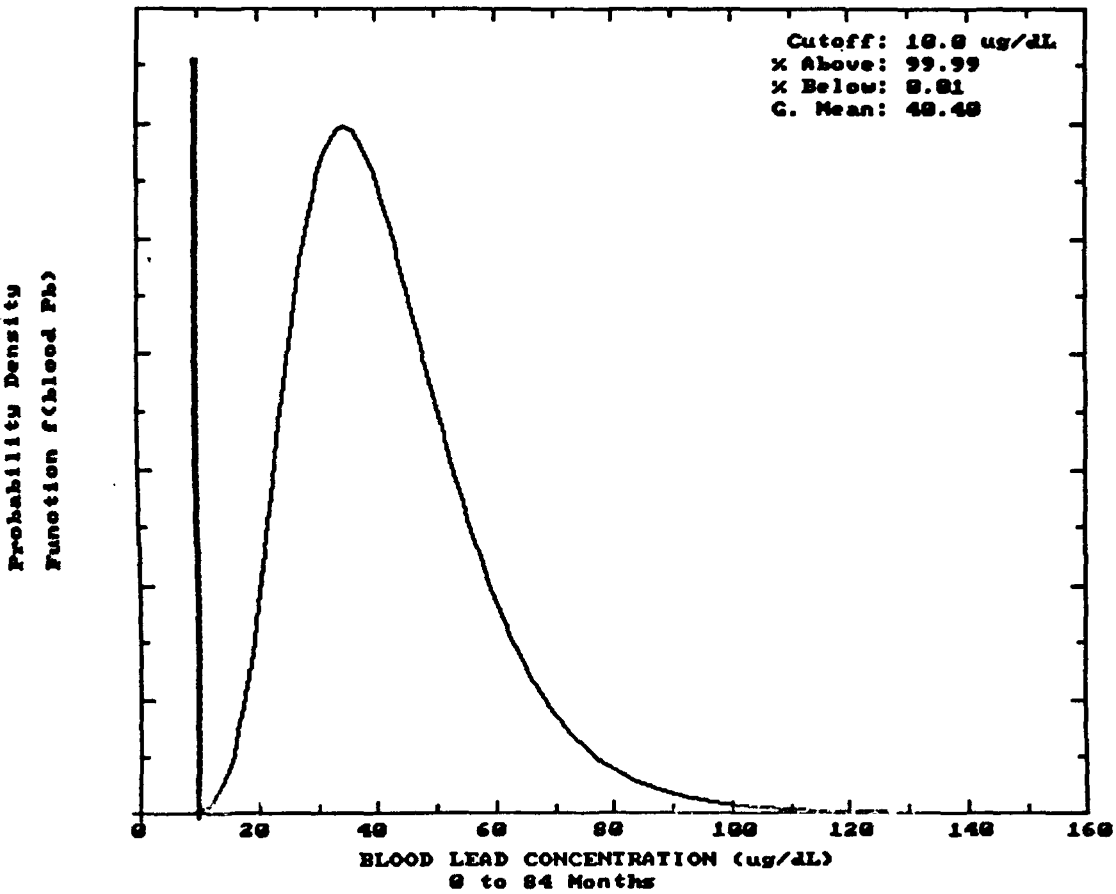
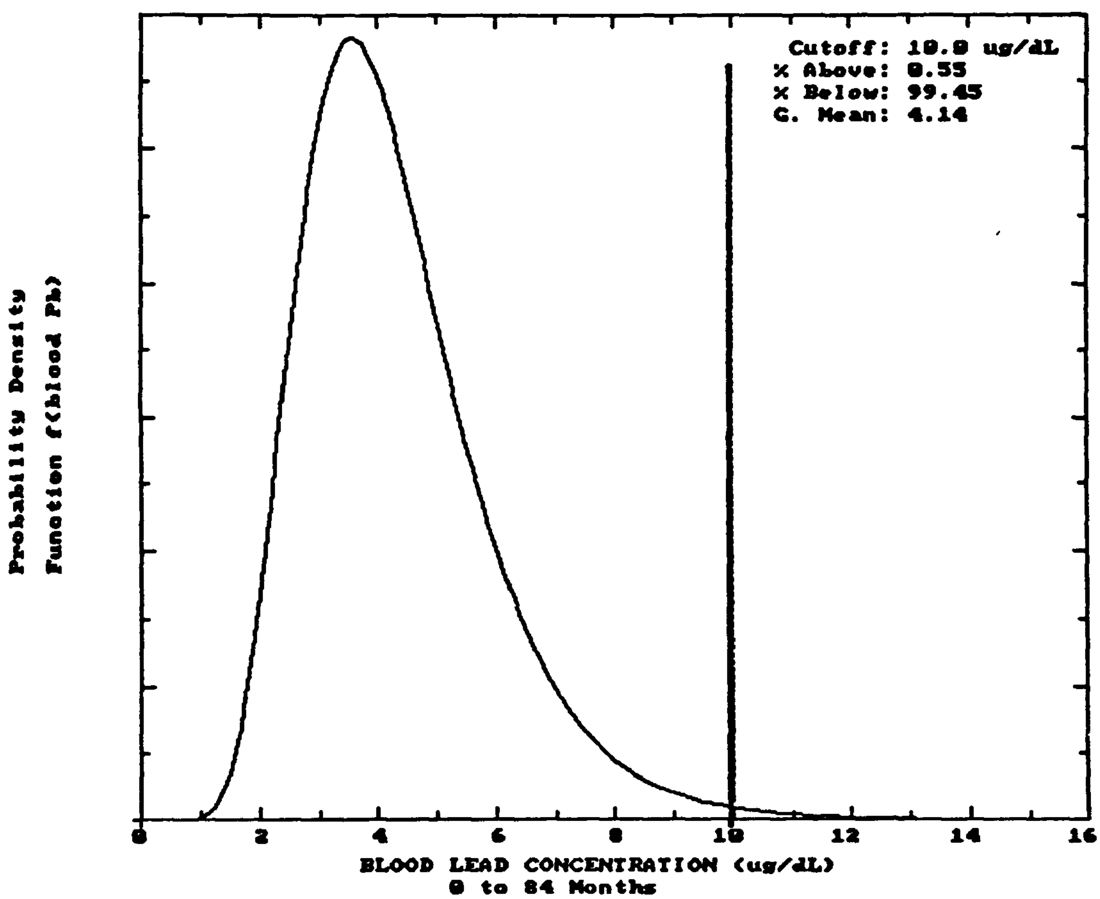


Figure 3

Input Value: Soil/Dust Lead Concentration = 500 ppm



Attachment 2

IDENTIFICATION AND EVALUATION OF REMEDIAL ACTION REQUIREMENTS

8.1 INTRODUCTION

In this Section and the following two Sections, potential remedial action alternatives are evaluated to address the contamination at the Sierra Blanca site. This evaluation is performed primarily by progressing through the series of analyses which are outlined in the National Contingency Plan (NCP), in particular, 40 CFR Section 300, the Interim Guidance on Superfund Selection of Remedy, December 24, 1986, Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.0-19, and the Additional Interim Guidance for FY 1987 Records of Decision, July 24, 1987 (OSWER Directive No. 9355.0-21). This process, in part, enables EPA to address the Superfund Amendments and Reauthorization Act (SARA) Section 121 requirements of selecting a remedial action that 1) is protective of human health and the environment, 2) meets Federal and State requirements that are applicable or relevant and appropriate, 3) utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and 4) is cost effective. Additionally, SARA Section 121 and the guidance documents referenced above require EPA to give preference to remedies which employ treatment which permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances as their principal element.

Section 121(b)(1) of SARA requires that an assessment be conducted of permanent solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants. SARA requires that the following treatment alternatives be developed:

"Treatment alternatives should be developed ranging from an alternative that, to the degree possible, would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce toxicity, mobility, or volume as their principal element. Although alternatives may involve different technologies (which will most often address toxicity and mobility) for different types of waste, they will vary mainly in the degree to which they rely on long-term management of treatment residuals or low-concentrated wastes. In addition to the range of treatment alternatives, a containment option involving little or no treatment and a no action alternative should also be developed"

Remedial alternatives are identified using the guidelines presented in Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA, 1988), Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites (U.S. EPA, 1988) and the Handbook for Remedial Action at Waste Disposal Sites (U.S. EPA, 1988).

Analysis of remedial alternatives is based on an evaluation of the following for each alternative:

- Degree to which alternative is protective of public health and the environment.
- Degree to which alternative meets applicable or relevant and appropriate requirements (ARARs).
- Technical feasibility.
- Cost/benefit analysis.

Identification and screening of remedial alternatives for the Sierra Blanca site were performed using the following steps:

- Development of Remedial Action Objectives (based on ARARs, risk assessment, etc.)

- Development of General Response Actions
- Identification of Volumes and Areas of Contaminated Media
- Identification and Screening of Remedial Technologies
- Evaluation of Process Options as to Effectiveness, Implementability and Relative Cost
- Assembly of Alternatives for Remediation

These steps are detailed in subsequent sections.

8.2 CONTAMINANTS OF CONCERN AND RISK BASED EXPOSURE CRITERIA

As discussed in Sections 4 and 7, groundwater at Sierra Blanca has not been impacted by site contaminants and is, therefore, not addressed in the FS.

The contaminant of concern in soils, discharge pit and tank sediments, and material piles at Sierra Blanca is lead. As discussed in Section 4 and 7, arsenic and other metals besides lead are found at elevated concentrations at the site. However, as discussed in Section 6, arsenic and the other metals present much less risk to human health than the risks posed by levels of lead found in the same materials at the site. A concentration of lead in soil exceeding 500-1000 ppm has been established as a cleanup criteria by EPA's Office of Emergency and Remedial Response and Office of Waste Program Enforcement, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive #93355.4-02, EPA, 1989). As discussed in Sections 4 and 7, lead levels far in excess of 500 ppm are present in various waste materials at the site. Only those areas of the site where lead levels are high are arsenic and other metals concentrations also elevated. By approaching the site remediation in a manner to address those areas where lead is found at concentrations above 500 ppm, elevated concentrations of arsenic and other metals will also be addressed.

8.3 ARAR-BASED EXPOSURE CRITERIA

Under Section 121(d)(1) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended in 1986 by the Superfund Amendment and Reauthorization Act (SARA), remedial actions must attain a degree of cleanup which assures protection of human health and the environment. Additionally, CERCLA remedial actions that leave any hazardous substance, pollutant, or contaminant on-site must meet, upon completion of the remedial action, a level or standard of control that at least attains standards, requirements, limitations, or criteria that are "applicable" or "relevant and appropriate" under the circumstances of the release. These requirements, known as "ARARs", may be waived in certain instances (see Section 121(d)(4) of CERCLA).

ARARs are derived from both Federal and State laws. Under Section 121(d)(2) of SARA, the Federal ARARs for a site could include requirements under any of the Federal environmental laws (e.g., the Solid Waste Disposal Act, the Clean Air Act, the Clean Water Act, and the Safe Drinking Water Act). State ARARs include promulgated requirements under the State environmental or facility siting laws that are more stringent than Federal ARARs and have been identified to EPA by the State in a timely manner. Subparagraph 121(d)(2)(c) of CERCLA limits the applicability of State requirements or siting laws which could effectively result in the statewide prohibition of land disposal of hazardous substances, pollutants, or contaminants unless certain conditions are met.

Subsection 121(d) of CERCLA requires that Federal and State substantive requirements which qualify as ARARs be complied with by remedies (in the absence of a waiver). State requirements can be waived if a State has neither consistently applied nor demonstrated the intent to consistently apply a requirement in similar circumstances at other remedial actions within the State (Subparagraph 121(d)(4)(E) of SARA). Federal, State or local permits do not need to be obtained for removal nor for remedial actions implemented on site (Subsection 121(e) of CERCLA), although substantive technical requirements will be attained.

The definitions of "applicable" or "relevant and appropriate" requirements as derived from the NCP are as follows.

Applicable requirements means those cleanup standards, standards of control and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a CERCLA site. For example, at a site with contaminated groundwater, Federal drinking water and State groundwater standards would be "applicable" if contaminated groundwater was being directly used as a drinking water source.

Relevant and appropriate requirements means cleanup standards, standards of control and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. For example, at a site with contaminated groundwater, Federal drinking water and State groundwater standards would be "relevant and appropriate" if the contaminated groundwater was not currently being used, but was a viable potential source of drinking water. Requirements may be relevant and appropriate if they would be "applicable" except for jurisdictional restrictions associated with the requirement.

The determination of which requirements are "relevant and appropriate" is somewhat flexible. EPA and the State may look to the type of remedial actions contemplated, the hazardous substances present, the waste characteristics, the physical characteristics of the site, and other appropriate factors. It is possible for only part of a requirement to be considered relevant and appropriate. Additionally, only substantive requirements need to be followed. See 40 CFR Part 300, March 8, 1990.

There are three types of ARARs. The first type includes "contaminant-specific" requirements. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of this type of ARAR are ambient water quality criteria and drinking water standards. A second type of ARAR includes location-specific requirements which set restrictions on certain types of activities based on site characteristics. These include restrictions on activities in wetlands, floodplains, and at historic sites. The third type of ARAR includes action-specific requirements. These are technology-based restrictions which are triggered by the type of action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage and disposal.

ARARs must be identified on a site-specific basis considering information about specific chemicals at the site, specific features of the site location, and actions that are being evaluated as remedies. If no ARAR covers a particular situation, or if an ARAR is not sufficient to protect public health or the environment, then non-promulgated standards, criteria, guidance, and advisories may be used to provide a protective remedy.

Tables 8-1 and 8-2 contain a listing of ARARs which have been evaluated for Sierra Blanca. These tables identify each potential ARAR and whether or not it is "applicable" or "relevant and appropriate". The remainder of this analysis describes and evaluates the three types of ARARs in greater detail.

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
FEDERAL – CONTAMINANT SPECIFIC					
• SAFE DRINKING WATER ACT	42 USC § 300g				
– National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards for public water systems (maximum contaminant levels)	No/No	Not ARAR because the site groundwater has not been contaminated by site-related activities.	As – 0.05 mg/L Pb – 0.05 mg/L Cd – 0.010 mg/L Hg – 0.002 mg/L Cr – 0.05 mg/L Se – 0.01 mg/L Ba – 1 mg/L Nitrate (as N) – 10 mg/L Ag – 0.05 mg/L
– National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare-based standards for public water systems (secondary maximum contaminant levels)	No/No	Not ARAR because the site groundwater has not been contaminated by site-related activities.	Cu – 1 mg/L Mn – 0.05 mg/L Fe – 0.3 mg/L pH – 6.5 to 8.5 SO_4 – 250 mg/L TDS – 500 mg/L Zn – 5 mg/L Cl – 250 mg/L
– Maximum Contaminant Level Goals	Pub. L No. 99-330, 100 Stat. 642 (1986)	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety	No/No	Not ARAR because the site groundwater has not been contaminated by site-related activities.	As – 0.05 mg/L Pb – 0.02 mg/L (withdrawn) Cu – 1.3 mg/L Cr – 0.12 mg/L Hg – 0.003 mg/L Se – 0.045 mg/L
– Underground Injection Control Regulations	40 CFR Parts 144-147	Provides for protection of underground sources of drinking water	No/No	No underground injection currently envisioned as remedial alternative (see New Mexico entries, following pages, regarding ground water protection standards).	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
• CLEAN WATER ACT	33 USC §§ 1251-1376				
- Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water	Sets criteria for water quality based on toxicity to aquatic organisms and human health	No/No	Human health criteria not ARAR because no contamination of groundwater or surface water is attributable to the site.	
• CLEAN AIR ACT	42 USC §§ 7401-7642				
- National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead)	No/No	No point source air emissions exist on site.	
- National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61	Sets emission standards for designated hazardous pollutants including mercury, beryllium, and inorganic arsenic	No/No	No air emissions of hazardous pollutants are generated at the site.	
- National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61, 140-161, 156	Specifies control requirements for asbestos handling and work practices to control emissions	No/No	Does not specify a threshold contaminant level. No asbestos apparent on site.	
• RESOURCE CONSERVATION AND RECOVERY ACT	42 USC §§ 6901-6987	Amended Solid Waste Disposal Act			
- Subtitle C (hazardous waste)	40 CFR Part 265, Subpart G, Sections 264.288 & 264.310	Specific closure requirements for impoundments and landfills	No/Yes	Consolidation on-site does not invoke RCRA; however, general RCRA guidelines are appropriate.	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
FEDERAL - ACTION SPECIFIC					
• RESOURCE CONSERVATION AND RECOVERY ACT	42 USC §§ 6901-6987	Amended Solid Waste Disposal Act			
- Subtitle C (hazardous waste)	40 CFR Part 265, Subpart G	Specifies closure requirements for hazardous waste impoundments and landfills	No/Yes	Wastes from the extraction, beneficiation, and processing of ores and minerals are currently excluded from regulation under RCRA. However, on-site disposal of mining waste occurred after November 19, 1980.	
- Subtitle D (solid wastes)	40 CFR Part 241, et. seq.	Specifies requirements for land disposal of solid waste including industrial wastes	Yes/Yes	If mining waste were to be disposed of in a sanitary or industrial landfill, Subtitle D regulations would apply. Not applicable for on-site actions.	
- Subtitle I (underground storage tanks)	40 CFR Part 280	Establishes regulations related to underground storage tanks	No/No	Underground storage tanks are not present on-site, and are not being considered for remediation.	
• FEDERAL MINE SAFETY AND HEALTH ACT	30 USC §§ 801-962	Regulates working conditions in underground mines to assure safety and health of workers	No/No	Under 40 CFR § 300.38, all applicable health and safety requirements apply to all response activities under the NCP; no underground workings are on site, however.	
• CLEAN WATER ACT					
- National Pollutant Discharge Elimination System	40 CFR Parts 122, 125	Requires permits for the discharge of pollutants from any point source into waters of the United States	No/No	A permit is not required for on-site CERCLA response actions, but the substantive requirements apply. However, no remediation or discharge of on-site groundwater or surface water is planned.	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
- Effluent Limitations	40 CFR Part 440	Sets technology-based effluent limitations for the Ore Mining and Dressing Point Source Category	No/No	Applies to ongoing mining and dressing operations.	
- National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly owned treatment works or which may contaminate sewage sludge	No/No	No water treatment or discharge to POTW is planned.	
• TOXIC SUBSTANCES CONTROL ACT	15 USC §§ 2601-2629				
- PCB Requirements	40 CFR Part 761	Establishes storage and disposal requirements for PCBs	No/No	No PCBs are identifed on the site.	
• URANIUM MILL TAILINGS RADIATION CONTROL ACT	42 USC § 7901-7942 42 USC § 2022	Establishes requirements related to uranium mill tailings	No/No	Uranium is not present on-site.	
• OCCUPATIONAL SAFETY AND HEALTH ACT	29 USC § 651-678	Regulates worker health and safety	Yes/Yes	Under 40 CFR § 300.38, requirements of this Act apply to all response activities under the NCP.	
• D.O.T. HAZARDOUS MATERIAL TRANSPORTATION REGULATIONS	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials	Yes/Yes	Will apply if selected remedial alternative involves transportation of hazardous materials.	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
LOCATION SPECIFIC					
• NATIONAL HISTORIC PRESERVATION ACT	16 USC § 470 40 CFR § 6.301(b) 36 CFR Part 800	Requires Federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places	No/No	The remedy does not affect any district, site, building, structure, or object listed on or eligible for the National Register.	
• ARCHEOLOGICAL AND HISTORIC PRESERVATION ACT	16 USC § 469 40 CFR § 6301(c)	Establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program	No/No	The remedy does not affect historical or archeological data.	
• HISTORIC SITES, BUILDINGS AND ANTIQUITIES ACT	16 USC §§ 461-467 40 CFR § 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks	No/No	The remedy does not affect any Natural Landmark.	
• FISH AND WILDLIFE COORDINATION ACT	16 USC §§ 661-666	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	No/No	There are no natural streams or other water bodies on-site.	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
• **ENDANGERED SPECIES ACT**	16 USC 1531 50 CFR Part 200 50 CFR Part 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend	No/No	None of the endangered species indigenous to Lincoln County were found on the site in a survey conducted by the U.S. Fish and Wildlife Service.	
• **CLEAN WATER ACT**	33 USC §§				
– Dredge or Fill Requirements (Section 404)	40 CFR Parts 230, 231	Requires permits for discharge of dredged or fill material into navigable waters	No/No	There will be no discharge of dredged or fill material into navigable waters as part of the remediation.	
• **RIVERS AND HARBORS ACT OF 1899**	33 USC § 403				
– Section 10 Permit	33 CFR Parts 320-330	Requires permit for structures or work in or affecting navigable waters	No/No	There will be no structures or work in or affecting navigable waters.	
• **EXECUTIVE ORDER ON PROTECTION OF WETLANDS**	Exec. Order No. 11,990 40 CFR § 6.302(a) and Appendix A	Requires Federal agencies to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	No/No	No remedial action is being considered that would affect a wetland.	
• **EXECUTIVE ORDER ON FLOODPLAIN MANAGEMENT**	Exec. Order No. 11,988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the adverse impacts associated with direct and indirect development of a floodplain	No/No	The site is not within a 100-year floodplain, according to FEMA maps.	
• **WILDERNESS ACT**	16 USC 1131 50 CFR 35.1	Administer Federally owned wilderness area to leave it unimpacted	No/No	No wilderness area on-site or adjacent to site.	

TABLE 8-1

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
FEDERAL STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
• NATIONAL WILDLIFE REFUGE SYSTEM	16 USC 668 50 CFR 27	Restricts activities within a National Wildlife Refuge	No/No	No Wildlife Refuge on-site or adjacent to site.	
• SCENIC RIVER ACT	16 USC 1271 40 CFR 6.302(e)	Prohibits adverse effects on scenic river.	No/No	No scenic river in area.	
• COASTAL ZONE MANAGEMENT ACT	16 USC 1451	Conduct activities in accordance with State approved management program.	No/No	Area is not in the coastal zone.	

TABLE 8-2

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
STATE STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)	
STATE - CONTAMINANT SPECIFIC						
• NEW MEXICO WATER QUALITY ACT	New Mexico Statutes, Title 74, Article 6	Surface and subsurface within or bordering upon New Mexico		Creates the Water Quality Control Commission, which has the duties and powers to set water quality standards and to regulate effluent to surface and subsurface waters.		
- New Mexico Water Quality Control Commission Requirements						
• Toxic Pollutant Criteria	1-101.U.U.	Water contaminant(s); groundwater of <10,000 TDS Effluent discharge to ground water	No/No	Not ARAR because the site has not resulted in groundwater contamination; the upper saturated zone is a Class IIIA aquifer; because no groundwater contamination was found; and because no treatment or reinjection of groundwater is proposed.	Arsenic (As)	0.1 mg/L
					Barium (Ba)	1.0 mg/L
					Cadmium (Cd)	0.01 mg/L
					Chromium (Cr)	0.05 mg/L
					Cyanide (CN)	0.2 mg/L
					Fluoride (F)	1.6 mg/L
					Lead (Pb)	0.05 mg/L
					Total Mercury (Hg)	0.002 mg/l
					Nitrate (NO_3 as N)	10.0 mg/L
					Selenium (Se)	0.05 mg/L
					Silver (Ag)	0.05 mg/L
					Uranium (U)	5.0 mg/L
					Radioactivity: Combined Radium-226 and Radium-228	30.0 pCi/l
					Benzene	0.01 mg/L
					Polychlorinated byphenyls (PCBs)	0.001 mg/l
					Toluene	0.75 mg/L
					Carbon Tetrachloride	0.01 mg/L
					1,2-dichloroethane (EDC)	0.01 mg/L
					1,1-dichloroethylene(1,1-DCE)	0.005 mg/l
					1,1,2,2-tetrachloroethylene (PCE)	0.02 mg/L
					1,1,2-trichloro-	

TABLE 8-2

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
STATE STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)	
					ethylene (TCE)	0.1 mg/L
					Ethylbenzene	0.75 mg/L
					Total xylenes	0.62 mg/L
					Methylene chloride	0.1 mg/L
					Chloroform	0.1 mg/L
					1,1-dichloroethane	0.025 mg/L
					ethylene dibromide (EDB)	0.0001 mg/L
					1,1,1-trichloroethane	0.06 mg/L
					1,1,2-trichloroethane	0.01 mg/L
					1,1,2,2-tetrachloroethane	0.01 mg/L
					Vinyl chloride	0.001 mg/L
					PAHs: total naphthalene plus monomethylnaphthalenes	0.03 mg/L
					Benzo-a-pyrene	0.0007 mg/L
					Chloride (Cl)	250 mg/L
					Copper (Cu)	1.0 mg/L
					Iron (Fe)	1.0 mg/L
					Manganese (Mn)	0.2 mg/L
					Phenols	0.005 mg/L
					Sulfate (SO_4)	600 mg/L
					Total Dissolved Solids (TDS)	1000 mg/L
					Zinc (Zn)	10.0 mg/L
					pH	between 6 and [illegible]
• General Requirements	2-101.A	Effluent discharge to a water course	No/No	Sets limitations on BOD, COD, settleable solids, fecal coliform bacteria, and pH. No remedial alternatives consider point discharge to the Rio Grande.		

TABLE 8-2

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
STATE STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
* Regulations for Discharges Onto or Below the Surface of the Ground	3-103.A, .B, .C	Discharge onto or below the surface of the ground	No/No	No groundwater treatment or reinjection is proposed for the Sierra Blanca site.	See list on pp 1 and 2
• NEW MEXICO WATER QUALITY STANDARDS		Surface waters of the State of New Mexico	No/No	Designates uses for which the surface waters of New Mexico shall be protected and prescribes the water quality standards necessary to sustain the designated uses.	
- General Standards	1-102	Discharge of a toxic pollutant to surface waters	No/No	Outlines the requirements for discharges of toxic substances to surface waters suitable for recreation and support of desirable aquatic life presently common in New Mexico waters. ARAR for point discharges to the Rio Grande.	
- Stream Use Designation and Standards	2-105	Discharges to the main stem of the Rio Grande from the headwaters of Elephant Butte upstream of the Angostura Diversion work	No/No	Sets standards for dissolved oxygen, pH, temperature, fecal coliform bacteria, TDS, sulfate, and chloride. No remedial alternatives consider point discharge to the Rio Grande.	
• NEW MEXICO AIR QUALITY CONTROL ACT					
- New Mexico Air Quality Standards and Regulations	201	Discharge of particulates, sulfur dioxide, hydrogen sulfide, reduced sulfur, carbon monoxide, nitrogen dioxide, photochemical oxidants, and nonmethanol hydrocarbons to the air.	No/No	Sets standards for discharges of these criteria to the air. ARAR for treatment effluent to the air. Such air emissions are not a part of considered remedial alternatives.	

TABLE 8-2

DETERMINATION OF
APPLICABLE OR RELEVANT AND APPROPRIATE
STATE STANDARDS, REQUIREMENTS, CRITERIA, AND LIMITATIONS

Standard, Requirement, Criteria, or Limitations	Citation	Description	Applicable/ Relevant and Appropriate	Comments	Relevant Standards (Units Shown)
• NEW MEXICO STATUTES, WATER LAW	Chapter 72, Article 12	Underground water statutes	No/No	Requires permits for installation of wells for consumptive use of ground water. No consumptive use will occur as a result of soil remediation.	
• SOLID WASTE MANAGEMENT REGULATIONS (DRAFT)	Solid Waste Management (SWM) Regulations (Draft), Part III, Section 301,302	Disposal of treatment residues	Yes/Yes	Establishes procedures for operation and closure of landfills for nonhazardous materials. Operation of an onsite landfill is evaluated as part of the remedy.	
	SWM Regulations (Draft), Part III, Section 304	Transportation of materials	Yes/Yes	Establish requirements for waste transfer stations. If operation of the treatment plant requires a transfer station be built for transportation of nonhazardous materials.	

8.3.1 CONTAMINANT-SPECIFIC ARARS

The contaminant pathways of concern are dermal exposure to and inhalation and ingestion of contaminated soils and waste material.

Solid Waste Disposal Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984, defines, under Subtitle C, those solid wastes which are subject to regulations as hazardous wastes. Municipal waste and waste from the extraction, beneficiation, and processing of ores and minerals (i.e. mine waste) are specifically excluded under Subtitle C. Subtitle D requires States to develop solid waste management plans and establish criteria to identify unsafe solid waste facilities or practices.

Mine waste may be subject to RCRA Subtitle C requirements to the extent that it is RCRA listed or RCRA characteristic waste and provided that these wastes were disposed after the effective date of the RCRA requirement. RCRA wastes have been identified at the Sierra Blanca site, and at least some disposal of the mine waste was after the effective date of the first RCRA technical requirements, i.e. November 19, 1980. Thus, RCRA Subtitle C is a relevant and appropriate requirement, especially if remedial action is taken which constitutes treatment, storage, or disposal of these wastes (as defined by RCRA).

8.3.2 LOCATION-SPECIFIC ARARS

Physical characteristics of the site influence the type and location of remedial responses considered for cleanup. The location-specific ARARs identified for the site in Tables 8-1 and 8-2 establish consultation procedures with Federal and State agencies and may impose constraints on the location of remedial measures or require mitigation measures.

The location-specific ARARs relate to historic preservation, fish and wildlife, wetlands, floodplains, and work in navigable waters. The location-specific ARARs influence the type and location of remedial alternatives developed for the site. No location-specific ARARs have been identified for the Sierra Blanca site.

8.3.3 ACTION-SPECIFIC ARARS

Action-specific ARARs set controls or restrictions on particular kinds of activities related to management of hazardous substances, pollutants, or contaminants. These requirements are not triggered by the specific chemicals present at a site but rather by the particular remedial activities that are selected to accomplish a remedy.

Potential action-specific ARARs which deal with requirements for the degree of treatment for remediation and disposal of contaminated groundwater or surface water are listed in Tables 8-1 and 8-2 as neither "applicable" nor "relevant and appropriate", since site activities have not resulted in contaminated groundwater or surface water.

Solid Waste Disposal Act (SWDA)

General RCRA Requirements - The Solid Waste Disposal Act was amended by the Resource Conservation and Recovery Act (RCRA) to control hazardous substances. The provisions of RCRA pertinent to the Sierra Blanca site have been promulgated under 40 CFR Parts 257, 260, 261, 262, 264, 268, and 280. EPA has determined that the above regulations are "applicable" to RCRA characterized and listed hazardous wastes (40 CFR Part 260), which either:

1) were disposed at a site after November 19, 1980; or 2) the CERCLA remedial action consists of treatment, storage, or disposal as defined by RCRA (40 CFR Part 264). In addition, these regulations are "relevant and appropriate" to RCRA hazardous wastes disposed at a site prior to November 19, 1980.

Some of the contaminants of concern at the Sierra Blanca site are listed in Appendix VIII of RCRA (40 CFR Part 261, App. VIII) and the wastes were disposed on-site after November 19, 1980. Therefore, the RCRA regulations are directly "applicable" for any future remedial action involving treatment, storage, and disposal as defined by RCRA. These regulations are "relevant and appropriate" for any other activities resembling RCRA regulated activities. However, currently, "waste from the extraction, beneficiation, and processing of ores and minerals" (40 CFR Part 261.4, 6, 7) is excluded from regulation under RCRA.

RCRA permits are not required for portions of CERCLA actions taken entirely on-site. Therefore, administrative RCRA requirements (i.e. reporting, record keeping, etc.) are not "applicable" or "relevant and appropriate" for on-site activities. However, all hazardous wastes disposed off-site are required by CERCLA 121(d)(3) to be in compliance with all pertinent RCRA requirements.

<u>RCRA Treatment Requirements</u> - CERCLA 121 establishes a preference for remedial actions involving treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a CERCLA site. The RCRA requirements are "applicable" at a site if: 1) the waste is hazardous; 2) the treatment complies with the RCRA definition contained in 40 CFR 260.10; and 3) the special jurisdictional

prerequisites in the pertinent subpart for each category of treatment are satisfied. Otherwise, the RCRA requirements are "relevant and appropriate".

RCRA Disposal Requirements - EPA has defined disposal under RCRA to be the movement (grading, excavation, etc.) of a RCRA hazardous waste originally disposed before the 1980 effective date of RCRA from within a "unit area of contamination" and placed in another location outside the "unit area of contamination". The RCRA requirements are "applicable" to activities of this type, and "relevant and appropriate" to similar activities.

In the case of the Sierra Blanca site, as with many CERCLA sites, there is no defined RCRA type "unit", but rather an "area of contamination" with differing waste types and levels of contamination. Therefore, excavation, treatment, and encapsulation conducted within the site would be within the "area of contamination" and not conform to the RCRA definition of disposal. The RCRA requirements are not "applicable". Any transport of wastes off-site do fall under the definition; the RCRA requirements are "applicable" in this case. The RCRA requirements may be "relevant and appropriate" for on-site activities. Using the disposal requirements in this manner requires the "design and operating" RCRA requirements. These include design requirements for landfills (including waste piles during construction), surface impoundments and land treatment units.

Land Disposal Requirements - The disposal of RCRA hazardous waste during the course of remedial action may also be subject to the special restrictions on land disposal of hazardous waste established by the Hazardous and Solid Waste Amendments of 1984 (HSWA). According to HSWA, all

RCRA hazardous wastes are to be reviewed by EPA to determine if they should be banned from land disposal. Banned waste cannot be placed in or on the land unless they have first been treated to levels achievable by best demonstrated available technology (BDAT) for each hazardous constituent in the waste.

EPA has defined placement and disposal to be identical. Whether the land restrictions are "applicable" or "relevant and appropriate" depend upon the disposal factors previously discussed. Any on-site excavation, treatment, or encapsulation of waste at the Sierra Blanca site does not follow the RCRA definition of disposal. Therefore, placement does not occur and the land disposal restrictions are not "applicable", nor are they considered "relevant and appropriate" until the EPA promulgates BDAT standards for RCRA soil and debris. However, any waste transported off-site for disposal does comply with the RCRA definition; the RCRA requirements are "applicable" in this case.

9.0 REMEDIATION ALTERNATIVES

9.1 REMEDIAL ACTION OBJECTIVES

To meet the overall objective of protecting human health and the environment, specific remedial action objectives are developed for contaminants of concern (COCs) within affected media. Remedial action objectives are defined in this section as either the chemical specific ARAR or the risk-based action level, whichever is more stringent. Based on sampling data and the Risk Assessment presented in Section 6, the contaminant of concern at Sierra Blanca is lead, with minimal additional health concerns associated with arsenic and other metals. As discussed in Section 8.2, a chemical specific action level of 500 ppm for lead is considered appropriate at Sierra Blanca. Only in those areas of the site where lead levels are high are other metals concentrations also elevated. Thus, by approaching the site remediation in a manner to address those areas where lead is found at concentrations above 500 ppm, elevated concentrations of arsenic and other metals will also be addressed.

The contaminated areas of the site consist of material piles of partially processed ore and tailings, tank sediments, discharge pit sediments and surficial soils. No subsurface soils or groundwater have been found to be contaminated, and there is no surface water on or near the site. Remediation measures will, therefore, be limited to the distinct on-site contaminant source areas, collectively referred to as the Sierra Blanca waste material.

9.1.1 CHARACTERISTICS OF CONTAMINATED MATERIAL

Based on the results of the RI, the contaminated areas at Sierra Blanca are shown in Figure 9-1, and some of the characteristics of those areas are presented in Table 9-1. The contaminated material is located in five material piles of partially processed ore and tailings; sediments from three discharge pits and a cinder block

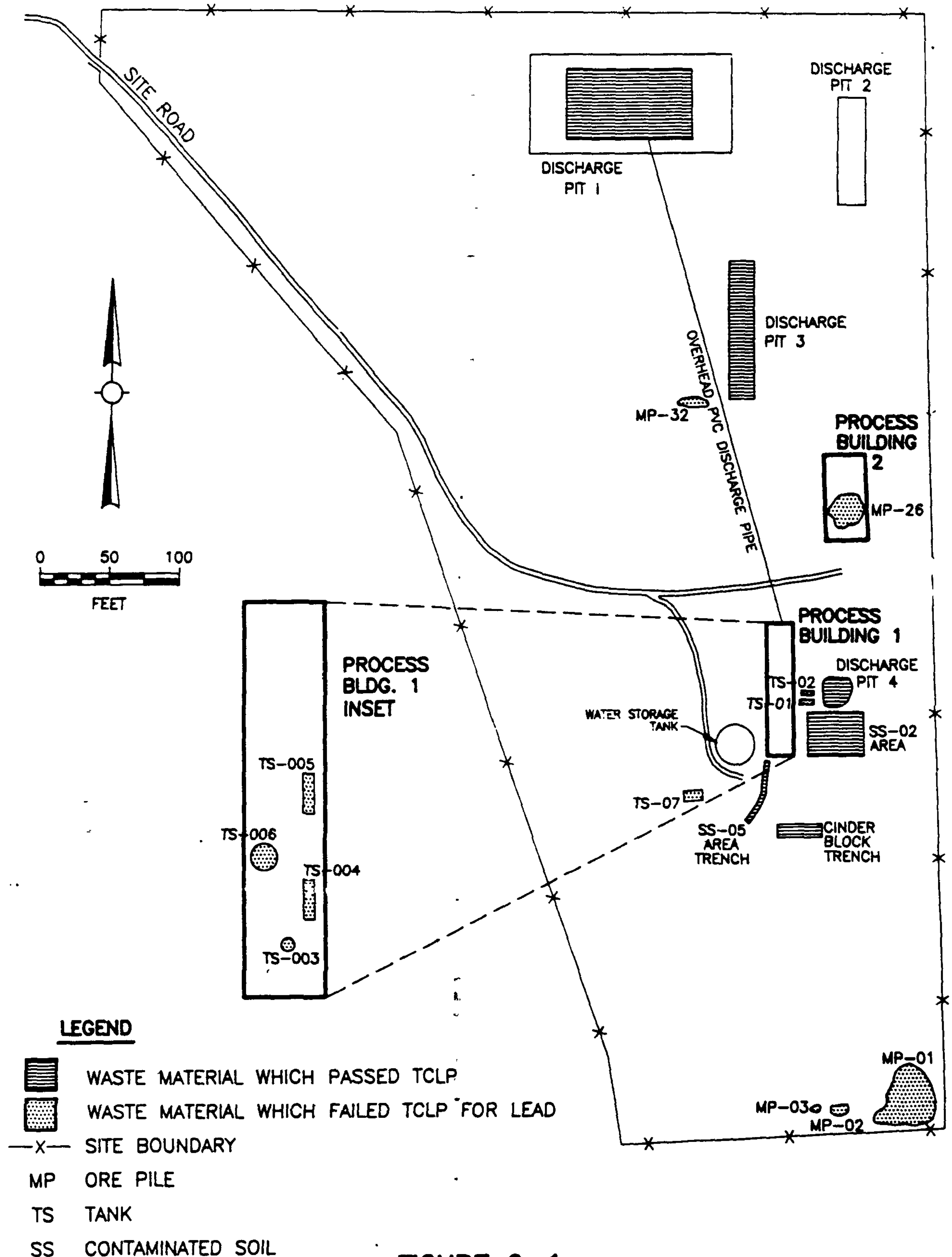


FIGURE 9-1

ESTIMATED EXTENT OF AREAS WITH LEAD CONCENTRATIONS GREATER THAN 500 PPM

CAMP DRESSER & McKEE INC.

TABLE 9-1

CHARACTERISTICS OF CONTAMINATED MATERIAL

Unit / Sample No.	Volume (C.Y.)	Arsenic mg/Kg	Lead mg/Kg
MATERIAL PILES			
MP-01	120	52.1	18,900
MP-26	53	51.7	18,700
MP-02	4	---	18,300
MP-03	2	---	16,320
MP-32	3	---	13,850
DISCHARGE PIT SEDIMENTS			
DP-01	167		7,850
DP-03	128	22.3	9,050
DP-04	30	79.6	5,140
SURFICIAL SOILS			
CBT	21	49.2	5,420
SS-02	15	25.5	10,409
SS-05	5	48	1,360
TANK SEDIMENTS			
TS-01	3	1,510	14,100
TS-02	1	51.4	5,520
TS-03	1	148	3,728
TS-04	1	5,160	46,400
TS-05	2	83	12,600
TS-06	2	66.5	9,490
TS-07	10	143	11,500
TOTAL VOL./AVG. CONC.	570	47	8,950

trench; surficial soils in two areas where contaminated runoff or spillage occurred; and fine textured sediments from seven separate tanks.

9.2 GENERAL RESPONSE ACTIONS

The general response actions identified for the Sierra Blanca site which will meet the remedial action objectives, or will provide a baseline against which actions may be compared, consist of the following:

- No Action. This response is identified for the purposes of establishing a baseline with which to compare other general response actions. There are no preventative or corrective actions taken as a result of this general response action; however, monitoring of the contamination may be prescribed.

- Institutional Controls. This response utilizes actions which control human contact with the contamination rather than remediating the contamination itself. These actions may be physical, such as fences or barriers, as well as legal actions and zoning actions.

- Containment in Place. As a general response action, containment prevents risk to human health and the environment by restricting contact or migration of the contaminants via soil, water, or air pathways. A number of technologies and different materials are available for use in establishing migration barriers. Containment in place is distinct from general response actions which require excavation of the contaminated material, such as landfill disposal.

- Treatment. This action involves removal of the contaminant from the contaminated media, or alteration of the contaminant to reduce its toxicity, mobility or volume. This general response action is usually preferred unless site or contaminant specific characteristics make it unrealistic.

- Disposal. This action involves the transfer of contaminated media, concentrated contaminants, or treated material to a site reserved for long-term storage of such materials. Disposal sites are strictly regulated in the operation and types of materials they may accept.

These general response actions are developed in the following sections.

9.3 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

A number of potentially effective technologies are associated with the general response actions selected for the site. In this Section, remedial action technologies potentially feasible for the Sierra Blanca site are identified and subjected to preliminary screening, which consists of evaluation on the basis of technical feasibility considering site conditions and characteristics of the waste.

The technologies considered potentially applicable to the Sierra Blanca site are listed in Table 9-2. A discussion of the technologies and process options associated with the general response actions, and the results of preliminary screening, are presented below.

9.3.1 NO ACTION

The NCP (1990) requires that No Action be evaluated as a potential remedy for all media types. The No Action alternative serves as a baseline for comparison of other alternatives. No Action means that no remedial activities would be conducted to remove or reduce the hazards on the site. Monitoring may be conducted, however, to

TABLE 9-2

IDENTIFICATION AND SCREENING OF
REMEDIAL ACTION TECHNOLOGIES
SIERRA BLANCA SITE

Response Action	Remedial Technology	Process Option	Screening Status
No Action	None	None	Required for Consideration
Institutional Controls	Resident Relocation	Temporary	Feasible
	Access Restrictions	Fencing	Feasible
	Use Restrictions	Deed Notices	Feasible
		Zoning Ordinances	Feasible
Containment in Place	Capping	All Options	Not Feasible Without Prior Consolidation Due to Number and Characteristics of Source Areas
	Dust Control	Vegetative Mat	Not Feasible Without Prior Consolidation Due to Number and Characteristics of Source Areas
Treatment	Fixation	Neutralization	Feasible
		Cement Solidification	Feasible
	Extraction	Soil Washing	Not Feasible Due to Complexity and Insufficient Volume
		Soil Flushing	Not Feasible Due to Dispersed and Shallow Source Areas
	Reprocessing	On-Site	Not Feasible Due to Low Grade and Insufficient Volume
		Off-Site	Not Feasible Due to Low Grade and Insufficient Volume
	Biological	Bacterial Degradation	Not Feasible at This Time for Mining and Milling Solid Wastes
	Thermal	In-Situ Vitrification	Not Feasible Due to Complexity and Cost
		Pyrolysis	Not Feasible Due to Complexity and Cost

TABLE 9-2

IDENTIFICATION AND SCREENING OF
REMEDIAL ACTION TECHNOLOGIES
SIERRA BLANCA SITE
(Continued)

Response Action	Remedial Technology	Process Option	Screening Status
Disposal	On-Site	Consolidation	Feasible
	Off-Site	RCRA Subtitle D (Municipal) Landfill	Feasible
		RCRA Subtitle C (Hazardous Waste) Landfill	Feasible
		Mine Shafts	Not Feasible Due to Implementation Difficulties

quantify the impacts associated with no remedial response.9.3.2

9.3.2 INSTITUTIONAL CONTROLS

Institutional controls potentially feasible for the Sierra Blanca site consist of access restrictions, deed notices and zoning restrictions.

Access restriction is aimed at preventing human exposure to contaminated waste material. This option typically consists of installation of signs warning of the potential hazards associated with the site, together with barriers, such as fences, to restrict site access. These measures are technically feasible.

Use restrictions would involve deed notices and zoning ordinances to regulate use of the property. Deed notices would permit notification of potential buyers of the property about past activities at the site. Zoning would allow classification of the site to restrict permissible uses. These measures are technically feasible.

9.3.3 CONTAINMENT IN PLACE

Containment technologies are remedies that employ a barrier to limit the mobility of a contaminant. The containment technologies considered in this section are limited to those which do not require excavation of the material. On-site disposal alternatives consisting of excavation, consolidation and disposal are evaluated as disposal options in subsequent sections.

Containment in place may consist of either capping the waste material or providing a means of preventing the spread of windblown dust. Capping controls include clay covers (RCRA cap), soil cement covers, bituminous pavement, and soil covers. Dust controls consist of a vegetative mat which is established on the waste material to prevent wind erosion. For tanks, capping would consist of providing a sealed cover. Waste material at the Sierra Blanca site is located in numerous different source areas which include waste piles, open pits and trenches, flat expanses of surface soils, and open tanks and process equipment. Some of these open tanks are located within buildings, and capping controls would be impractical or cumbersome to implement. Due to the number, dispersal, and individual characteristics of the source areas, technologies that provide containment in place without some associated excavation and consolidation are not considered feasible, and are eliminated from further consideration. Consolidation of the material and disposal on-site is feasible, however, and is discussed in subsequent sections.

9.3.4 TREATMENT

Treatment technologies that are potentially feasible for the Sierra Blanca waste material are fixation, extraction, reprocessing, and biological and thermal techniques.

Fixation

Fixation technologies applicable to mining and milling wastes include neutralization and solidification; the latter also being referred to as physical encapsulation or immobilization. Neutralization involves the addition of materials with large acid neutralization capacity, such as kiln dust, which raises the pH of an acidic environment with the accompanying fixation of metals as metallic hydroxides. Solidification consists of the fixation of contaminant metals by chemical binding and physical encapsulation from the addition of solidification agents, which make the contaminants unavailable to oxidation and leaching.

As discussed in Sections 4 and 7, Toxicity Characteristic Leaching Procedure (TCLP) analyses was conducted on the various types of waste material at Sierra Blanca, as part of the XRF program. The findings of the TCLP analyses indicate that material piles (MP-01, MP-02, MP-03, MP-26 and MP-32) which consist of crushed ore material, and contaminated tank sediments (TS-01 through TS-07), do leach significant quantities of lead when subjected to TCLP test conditions. Arsenic and barium, which were also analyzed per TCLP, are far below regulatory limits. Notably, contaminated discharge pit sediments and contaminated soils subjected to TCLP analyses, did not result in the leaching of any of the tested constituents above regulatory limits. This indicates that contaminated discharge pit sediments and soils at Sierra Blanca will not be classified as RCRA hazardous wastes, but the tank sediments and contaminated material piles do exhibit RCRA hazardous waste characteristics with respect to leaching potential.

Based on the TCLP results, fixation processes may be applicable to contaminated material piles and tank sediment at Sierra Blanca, but may not be necessary for the contaminated soils and discharge pit sediments.

Neutralization

Neutralization of acid formation in the waste material, which results in inhibition of contaminant mobility, can be achieved through the addition of sodium compounds, such as soda ash, or calcium containing materials, such as lime, cement kiln dust, or fly ash.

To determine if neutralization is a feasible response action, neutralization bench scale testing is currently being performed on representative samples of the waste material. The results of the bench scale testing are to be presented as an addendum or supplemental report. At this time, it is assumed that neutralization is a viable treatment alternative, and this technology is retained for further evaluation.

Solidification

Several processes have been developed to immobilize metals in soils by solidification. These involve mixing the contaminated soils with cement or proprietary chemicals to solidify the mass and prevent leaching of metals. In addition to Portland cement, solidification agents include thermoplastics and organic polymers. Many of these treatments are combined with acid neutralization, which will immobilize the metals through conversion to insoluble carbonate and hydroxide forms, as well as encase them in a solidified mass.

Pilot testing of solidification treatment methods are required to determine the feasibility of this response action. If the solidified material passes the toxicity characteristic leaching procedure (TCLP) test, then treatment is successful and the material is suitable for unclassified disposal. To assess the feasibility of solidification as a treatment option, bench scale tests are being performed on representative samples of the Sierra Blanca waste material. Since the volume of the waste material potentially requiring solidification is comparatively small (225 cy), the use of a proprietary solidification process is not cost effective. Based on interviews with representative vendors, it appears that 8,000 to 10,000 cubic yards of material are necessary to warrant mobilization of proprietary fixation treatment process equipment. For this reason, bench scale testing of solidification treatment is limited to Portland cement of various mix compositions.

The results of the bench scale testing will be presented as an addendum or supplemental report. Since cement solidification is feasible, this technology is retained for further evaluation.

Extraction

Extraction process options for Sierra Blanca waste material include soil washing and soil flushing. Both remove leachable and/or extractable contaminants from the soil matrix. The ability of these processes to lower the concentrations of metals depends on the characteristics of the waste material and the contaminants. Contaminants which are incorporated into the soil matrix are not readily available for extraction processes. For example, lead contamination in tailings from mining and milling operations is commonly incorporated into crystal matrices, which would also be the case for unprocessed ores. Without other physical treatment, only the amorphous form of the metals may be recovered. Since this is also the form that would leach from contaminated soils, removal of this fraction would be protective of human health and the environment. Extraction processes may, therefore, be feasible for the material pile and tank sediment materials that failed the TCLP test.

Soil Washing

Soil washing would involve the addition of acidic or chelating agents to excavated waste material to bind the metal contaminants. The physical process of mixing usually occurs in mobile units and helps to distribute the chemicals, enhance binding, and remove the chemical-metal complex from the soil. The washed material together with liquid contaminated with chemical-metal complexes are then separated from the solution by pH dependent treatment processes, depending on the chemical agent used. Following dewatering of the metal complexes, a sludge exists for disposal as hazardous waste. The liquid may be regenerated for further use or disposal to a Publicly Owned Treatment Works (POTW).

Soil washing would be feasible to implement although equipment requirements are substantial. Equipment requirements for a soil washing process would include a screen, chemical storage and feeding equipment, mixing tanks, clarifier, and dewatering equipment. Water separated from the process could be discharged to the Carrizozo POTW, and dewatered sludge containing the metal complexes would be transported to a hazardous waste landfill. The equipment requirements for soil washing are greater than other feasible soil treatment processes, such as fixation. This process also suffers from the disadvantage that a separate liquid waste stream is created. Also, the effectiveness of soil washing as a treatment option cannot be properly evaluated without bench and pilot scale tests. Due to the relatively small volume of material present at the Sierra Blanca site, and the complexity associated with a soil washing process and likely high costs, this technology is eliminated from further consideration.

Soil Flushing

Soil flushing uses the same processes as soil washing for chemical binding, treatment of the contaminated liquid, and separation of the metal complexes from the liquid. It is an in-situ process, and differs from soil washing in that the mixing process occurs through injection of the washing solution directly into the unexcavated material, rather than in mobile units or tanks. Removal of the liquid with complexed metals is then accomplished through the use of extraction wells and infiltration galleries. The advantage of this option is that excavation of the material is not required.

For the Sierra Blanca site, the waste material is located in numerous different source areas, some of which are in the form of above grade material piles or tanks which contain contaminated sediments. Soil flushing process options would not be feasible for the above ground material. The remaining waste material is characterized by relatively thin layers of surficial soils. Given the shallow depths (approximately two feet), and the fact that this material is not contiguous, installation and operation of injection and extraction wells would not be practical. For these reasons, soil flushing process options are eliminated from further consideration.

Reprocessing

Reprocessing wastes to extract recoverable metals, and render the waste non-hazardous in the process, is a response action that has been evaluated for other EPA Superfund sites involving mining and milling wastes. This remedial technology generally consists of establishing a milling process on-site or transporting the wastes to an operating facility. Processes normally considered include pyrometallurgical (smelting process) or hydrometallurgical (chemical leaching or froth flotation process).

For the Sierra Blanca site, there is insufficient volume of waste material to consider implementation of an on-site reprocessing option. For off-site reprocessing, the only waste material which would be potentially suitable would be the material piles and perhaps some of the tank sediments. These materials contain a metals content sufficiently high to possibly make them acceptable to a smelting facility. The contaminated surficial soils and discharge pit sediments have generally low level metals contamination and, if excavated, would contain impurities such as organic matter and debris. This material would not be acceptable to existing smelting or metals refining facilities for reprocessing. Although the material piles and tank sediments comprise only about 225 cubic yards of material, this technology is attractive since it may be very simple to implement. Additionally, this response action could work well in conjunction with another remedial technology for the discharge pit sediments and surficial soils.

To investigate the feasibility of off-site reprocessing of the ores and tank sediments, a survey of metals smelting and refining facilities was conducted. The operations manager of the nearest operating lead smelter to the site was contacted to discuss the reprocessing option. After having a sample of the Sierra Blanca waste material assayed for precious metals and lead content, the operations manager determined that he was not interested in accepting the material for reprocessing.

Biological

Biological treatment technologies are commonly applied to treatment of organic contaminants. For inorganic contaminants, biological methods have been used in wetlands treatment systems for acid drainage from tailings piles and to remove metals. For the metals contamination in the ores, tank sediments, and surficial soils at the Sierra Blanca site, biological treatment would have a very limited potential. One recently developed technology involves seeding the waste material with special surfactants which inhibit the growth of iron bacteria, the metal/pyrite oxidizers which create acids. This, in turn, enhances the growth of sulfate reducing bacteria which converts acids back into pyrite materials.

In this treatment method, the material is consolidated, graded, and seeded with the surfactants in capsules which provide a timed release over an approximate three-year period, and which should be effective in reducing iron bacteria for seven years. After seven years, revegetation can start acting as a control on the recurrence of the bacteria by inducing genesis of a normal soil that naturally controls the iron bacteria. This occurs through the generation of natural organic acids and the presence of beneficial heterotrophic bacteria that compete for nutrients with the iron bacteria.

While promising, biological treatment of tailings and soils with metals contamination has not been proven in full-scale applications. Thus, the long-term effectiveness of this technology is unknown. Due to the many uncertainties currently associated with this technology, and the small volume of waste to be treated, biological treatment of Sierra Blanca wastes is eliminated from further consideration.

<u>Thermal</u>

Thermal treatment process options applicable to tailings and surficial soils with metal contamination are in-situ vitrification and pyrolysis. In-situ vitrification is a thermal treatment process that converts contaminated solid material into a chemically inert and stable crystalline product. It is a technology that is potentially applicable to immobilize contaminants in the waste material at the site. Pyrolysis utilizes extremely high temperatures in the absence of oxygen to dissociate wastes into their component atoms. Cooling results in recoverable streams of metals, siliceous materials, and gases. This process option is technically feasible for the metals contaminated waste material on the site.

Both the in-situ vitrification and the pyrolysis process would be difficult to implement for treatment of Sierra Blanca wastes. Both processes are complex to construct and operate, both have extensive equipment requirements, and both would produce gas sidestreams which would require further treatment. Additionally, the availability of services, equipment, and skilled workers for these processes is limited. Costs to implement either option would be very high compared to other feasible treatment technologies. For these reasons, neither in-situ vitrification nor pyrolysis are feasible, thus thermal treatment of Sierra Blanca wastes is eliminated from further consideration.

9.3.5 DISPOSAL

Disposal technologies potentially feasible for the Sierra Blanca waste material include consolidation and disposal on-site, excavation and removal to an off-site municipal or hazardous waste landfill, or excavation and disposal in an abandoned mine shaft. These disposal options may be implemented in association with fixation and reprocessing options previously discussed.

On-Site

Whereas containing the wastes in place by capping, vegetative mats, or other means is not feasible due to the number and character of individual source areas on the site, consolidating the wastes in a central on-site location would be feasible in conjunction with suitable controls to prevent the spread of contamination. Disposal of the material on-site would be protective of human health and the environment with a properly designed containment cap over the pile, or with fixation processes to address leachable materials.

Given the characteristics and climate of the Sierra Blanca site, an appropriate disposal location could consist of an unlined cell with a soil cover, and monitoring wells. This design would prevent intrusion of surface water into the fill, and allow for periodic monitoring of the groundwater at the site.

If the wastes which have been found to be characteristically hazardous by the TCLP tests are not treatable by fixation or reprocessing, then a RCRA Subtitle C-compliant landfill, or RCRA vault, would be relevant and or appropriate, unless a variance to the Land Ban (40 CFR Part 268) regulations were granted by EPA and the State of New Mexico. This landfill would have a double liner, leachate collection system, impermeable cap, surface water run-on/run-off controls, and groundwater monitoring system. Due to the extensive construction and operational standards associated with these facilities, the relatively low volume of contaminated material present, and the availability of other RCRA Subtitle C-compliant hazardous waste landfills within reasonable distances, construction of an on-site RCRA vault for Sierra Blanca wastes is not considered feasible, and is eliminated from further consideration. However, construction of a RCRA Subtitle D-compliant landfill is feasible and is retained for further consideration.

Off-Site

The off-site disposal options for Sierra Blanca waste materials are municipal or hazardous waste landfills or abandoned mine shafts.

Municipal Landfill

The wastes may be disposed of in a municipal landfill if they are not characteristically hazardous. However, the municipal landfill must also be willing to accept the waste. Several landfill operators in the vicinity of the site were contacted to determine if the Sierra Blanca wastes are suitable for disposal in their facility. Even though much of the waste has been determined to be non-hazardous, per TCLP, and other wastes may be treatable by fixation processes prior to disposal, some operators are unwilling to accept Superfund wastes in their municipal landfills. Other operators, however, would be willing to accept the waste provided it was certified as non-hazardous, and provided this method of disposal is acceptable to the State of New Mexico and EPA. Municipal landfill disposal, therefore, appears to be feasible and is retained for further evaluation.

Hazardous Waste Landfill

Characteristically hazardous wastes must be disposed of in a hazardous waste landfill, unless a variance to RCRA regulations is given to the wastes by EPA and the State of New Mexico. The closest Suitable permitted hazardous waste landfills that would accept the wastes are located in Nevada, Utah, and Colorado. Given the availability of these facilities within reasonable transportation distance from the Sierra Blanca site, this disposal option is retained for further evaluation.

Abandoned Mine

Another possible disposal option consists of excavating the waste material and disposing of it in an abandoned mine in the vicinity of the site. An initial criterion for the acceptability of a potential mine disposal site is that the proposed repository should be above seasonal high groundwater levels in the mine to prevent the possibility of leaching.

To assess the feasibility of this approach, the New Mexico Abandoned Mine Lands Bureau was contacted, as this agency would have regulatory authority over any potential mine disposal site. After considering this method of disposal, the Abandoned Mines Bureau determined that they would not be able to accept Superfund wastes at their abandoned mines sites. Disposal of Sierra Blanca waste material in an abandoned mine is therefore eliminated from further consideration.

9.4 CRITERIA FOR ALTERNATIVES DEVELOPMENT

In evaluating and screening technologies, the process options associated with the technology types determined to be potentially feasible are evaluated and screened in terms of relative effectiveness, implementability, and cost. Primary emphasis of the evaluation is placed on effectiveness in protecting human health and the environment; however, implementability and cost evaluations are also important. Each of these three evaluation criteria are described briefly below.

- Effectiveness

  Specific process options that have been identified should be evaluated with respect to their effectiveness relative to other process options within the same technology type. This evaluation should focus on the following (U.S. EPA, 1988):

  1) The potential effectiveness of process options in handling the estimated areas or volumes of media and meeting the contaminant reduction goals identified in the general response actions;

  2) The effectiveness of the process options in protection of human health and the environment during the construction and implementation phase; and

  3) How proven and reliable the process is with respect to the contaminants and conditions at the site

- Implementability

  Implementability encompasses both the technical and institutional feasibility of implementing a technology process. Technical implementability is used as an initial

TABLE 9-3

SIERRA BLANCA SITE
EVALUATION OF FEASIBLE REMEDIATION TECHNOLOGIES

Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	None	None	Does not achieve remedial action objectives	Requires administrative, legal, and regulatory efforts	None
Institutional Controls	Resident relocation	Temporary	Would reduce exposure threat during remediation; would not be necessary with appropriate controls during material excavation	Few residents to relocate; may be locally unpopular	Low capital, no O&M
		Permanent	Would remove exposure threat to nearby residents; would not reduce contamination	Few residents to relocate; may be locally unpopular	Moderate capital, no O&M
	Access Restrictions	Fencing	Would minimize exposure threats by limiting access	Readily implementable	Low capital, low O&M
	Use Restrictions	Deed Notices	Depends on intensity of future enforcement; would not reduce potential exposure risks	Readily implementable	Negligible
		Zoning Ordinances	Latitude allowed by regulations may limit effectiveness; would not reduce potential exposure risks	Readily implementable	Negligible
Treatment	Fixation	Neutralization	Effective in reducing toxicity and mobility of contaminants	Readily implementable; would require crushing of ores	Moderate capital, low O&M
		Solidification	Effective in reducing toxicity and mobility of contaminants	Readily implementable	Moderate capital, low O&M
	Reprocessing	Off-Site	Effective in rendering wastes non-hazardous and in recovering metals; not effective for surficial soils	Readily implementable for ores and tank sediments	Low capital, no O&M
Disposal	On-Site	RCRA Subtitle D Landfill	Effective in reducing mobility of contaminants	Implementable if wastes are not characteristically hazardous	Moderate capital, moderate O&M
	Off-Site	RCRA Subtitle D (Municipal) Landfill	Effective in reducing mobility of contaminants	Implementable if wastes are not characteristically hazardous	Moderate capital, no O&M
		RCRA Subtitle C (Hazardous Waste) Landfill	Effective in reducing mobility of contaminants	Readily implementable	High capital, no O&M

screen of technology types and process options to eliminate those that are clearly ineffective or unworkable at the site. Therefore, this subsequent, more detailed evaluation of the process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for off-site actions, the availability of treatment, storage, and disposal services (including capacity), and the availability of necessary equipment and skilled workers to implement the technology.

- Cost

  Cost plays a limited role in the screening of process options. Relative capital and operations and maintenance (O&M) costs are used rather than detailed estimates at this stage in the process. The cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type that achieve the same degree of protectiveness.

Screening of the feasible technology process options on the above basis is conducted in order to identify processes representative of the particular response action. This screening process is illustrated in Table 9-3.

9.5 DEVELOPMENT OF REMEDIATION ALTERNATIVES

In developing remediation alternatives for the Sierra Blanca Site, general response actions were combined using technologies developed and summarized in Table 9-3. The Alternatives considered feasible and suitable for continued evaluation are described below.

Although No Action does not achieve the remedial action objectives, this alternative is required for consideration. No action, while not involving remediation of the waste material, will require some level of cost to implement which are evaluated in Section 10.

Of the Institutional Controls available, only access, land use, and deed notices are considered appropriate. These restrictions will be relatively simple to implement, as zoning regulations already exist in Carrizozo, and adding access controls and deed notices should not be difficult. Relocation of residents, either on a temporary or permanent basis, should not be necessary, as adequate measures can be provided to protect nearby residents during site remediation activities.

Feasible treatment alternatives for this site are limited, and only solidification fixation using Portland cement or similar compounds appears feasible at this time. Results of bench scale tests on neutralization processes, currently underway, may also demonstrate the suitability of this approach. Both neutralization and solidification require similar remediation activities, and are expected to provide a similar level of treatment at similar costs. Thus, for the purpose of development and detailed evaluation of alternatives, only one of these treatment methods is evaluated. Cement solidification is selected for more detailed evaluation; chemical neutralization will not be further considered unless the bench scale test results indicate that greater treatment efficiency or equivalent treatment efficiency and cost advantages are possible using this technology.

Disposal alternatives include on-site disposal in an RCRA Subtitle D-compliant landfill, which would require treatment of the leachable material (material piles and tank sediments) prior to disposal. Off-site disposal in a municipal landfill would be feasible provided the leachable material is first treated. Otherwise, the material would require disposal in a hazardous waste landfill.

Considering the above requirements, the feasible treatment and disposal technologies are combined into Alternatives 3, 4, and 5, as shown on Table 9-4. These alternatives are evaluated in detail in Section 10.

TABLE 9-4

SIERRA BLANCA SITE
REMEDIATION ALTERNATIVES

Alternative	Description
1. No Action	No action to reduce the toxicity, mobility, or volume of contaminants
2. Institutional Controls	Access, land use, and deed restrictions
3. Cement Solidification / On-Site Disposal	Excavate contaminated material; treat leachable material piles and tank sediments by cement solidification; dispose on-site
4. Cement Solidification / Off-Site Municipal Landfill Disposal	Excavate contaminated material; treat leachable material piles and tank sediments by cement solidification; transport to and dispose in municipal landfill
5. Off-Site Municipal and Hazardous Waste Landfill Disposal	Excavate leachable material piles and tank sediments; transport to a permitted hazardous waste disposal facility. Excavate non-leachable surficial soils and discharge pits; transport to and dispose in municipal landfill

10.0 DETAILED EVALUATION OF ALTERNATIVES

A total of five alternatives for the Sierra Blanca site remediation are analyzed in detail in this section. The alternatives that are evaluated consist of the following:

Alternative 1	-	No Action
Alternative 2	-	Institutional Controls
Alternative 3	-	Cement Solidification/On-Site Landfill Disposal
Alternative 4	-	Cement Solidification/Off-Site Municipal Landfill Disposal
Alternative 5	-	Off-Site Municipal and Hazardous Waste Landfill Disposal

10.1 EVALUATION CRITERIA

Each of the above alternatives are described in this Section by providing the following information, as appropriate:

- Detailed description of remediation activities
- Treatment schematic
- Size and configuration of remediation components
- Treatment rates
- Space requirements
- Site layout
- On-site and off-site activities
- Required permits
- Time frame required to achieve remediation goals
- Detailed capital and O&M costs
- Present worth of remediation costs

The detailed evaluation process is a structured format, designed to provide relevant information needed to adequately compare and evaluate feasible alternatives to allow selection of an appropriate remedy for the site by EPA through the Record of Decision (ROD) process. The remedy must meet the following statutory requirements:

- Be protective of human health and the environment;
- Attain ARARs (or provide grounds for invoking a waiver);
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable;
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element, or provide an explanation in the ROD as to why it does not; and
- Be cost effective.

Nine evaluation criteria have been developed by EPA to address the statutory requirements listed above and to address additional technical and policy considerations that have proven to be important for selecting remedial alternatives. These criteria are listed and briefly described below:

- Overall Protection of Human Health and the Environment - How well the alternative reduces risks to human health and the environment, through treatment, engineering or institutional controls.
- Compliance with ARARs - How well the alternative complies with all applicable or relevant and appropriate requirements or, if a waiver is required, how it is justified.
- Long-Term Effectiveness and Permanence - How well the

alternative maintains long-term effectiveness in protection of human health and the environment. Alternatives which afford the highest degree of long-term effectiveness and permanence are those that leave little or no waste at the site.

- Reduction of Toxicity, Mobility, or Volume through Treatment - Anticipate performance of the specific treatment technologies that an alternative may employ and their ability to destroy or irreversibly treat contaminants.

- Short-Term Effectiveness - How well the alternative protects human health and the environment during construction and implementation of a remedy.

- Implementability - Whether or not the alternative is technically and administratively feasible, and whether or not the required goods and services are available.

- Cost - Analysis of capital and O&M costs of each alternative to determine cost-effective remedies. Cost estimates are developed with relative accuracy (-30 to +50%) and are presented as present worth costs so that alternatives can be reasonably compared.

- State Acceptance - To be completed for the most part after the public comment period; this criterion describes the preference of the State or support agency.

- Community Acceptance - To be completed for the most part after the public comment period; this criterion reflects the preferences of the community.

Each of the five alternatives for Sierra Blanca contamination are individually evaluated then comparatively analyzed on the basis of the first seven of the nine criteria above. The last two criteria (State and community acceptance) will be fully addressed in the Record of Decision (ROD) after the public comment period.

10.2 ALTERNATIVE 1: NO ACTION

10.2.1 DESCRIPTION

The No Action alternative (Alternative 1) provides a baseline for comparing other remedial alternatives for the Sierra Blanca site. Because no remedial activities would be implemented to mitigate contamination present at the site under this alternative, long-term human health and environmental risks for the site are as presented in the baseline risk assessment in Section 6. Although Alternative 1 does not include any remediation of contamination, it would consist of continued periodic monitoring of groundwater quality so that human health and environmental risks posed by site contaminants could be re-evaluated on a periodic basis.

10.2.2 CRITERIA ASSESSMENT

Alternative 1 is implementable; however, it provides no treatment, engineering, or institutional measures to control the exposure of receptors to contaminated material. No reduction in risks to human health and the environment would occur.

No controls for exposure, other than the existing fence, and no long-term or short-term site management are included under Alternative 1. This alternative provides no reduction in the toxicity, mobility, or volume of the contaminated ores, tank sediments, and surficial soils on the site. All existing and potential future risks associated with the site would remain. With respect to groundwater, no effects from site contaminants have been detected. With respect to soils, quantifiable risks are present which consist of hazards arising from potential exposure to lead, with limited additional effects from other metals (Section 6).

Alternative 1 would not provide any increased protection to human health or the environment, and it would not be in compliance with ARARs due to requirements imposed by RCRA Subtitles C and D regarding disposal of mining wastes, and due to New Mexico solid waste regulations.

10.2.3 COST ESTIMATE

Although Alternative 1 is to provide no action, some expenditure of capital costs would be required. These would be for installation of two additional monitoring wells on the site. These wells would be required together with the existing wells to allow proper long-term monitoring of the groundwater which flows away from the site. Indirect capital costs are also required for engineering and design of the monitoring well installation, contingency funds, mobilization/demobilization costs, and associated legal and regulatory costs. These indirect capital costs are included as an estimated percentage of the direct capital costs in all of the remediation alternative cost estimates.

Annual operation and maintenance (O&M) costs would include semi-annual groundwater sampling and analysis for TAL metals for an estimated 30-year period. Indirect O&M costs include administration costs and a maintenance reserve and contingency fund.

The estimated present worth cost for Alternative 1 is $48,000 and is detailed in Table 10-1. The present worth cost is based on an assumed life of 30 years and an annual interest rate of 9 percent.

TABLE 10-1
ALTERNATIVE 1: NO ACTION
PRELIMINARY COST ESTIMATE

Description: Periodic ground water monitoring
Interest Rate: 9%
Level of Accuracy: +50% to -30%

DIRECT CAPITAL COSTS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST
Install Additional Monitoring Wells	Each	2	$5,000	$10,000
TOTAL DIRECT CAPITAL COSTS				$10,000
INDIRECT CAPITAL COSTS				
1. Engineering & Design (15%)				$1,500
2. Contingency (25%)				2,500
3. Other Indirect Costs				
a. Legal (5%)				500
b. Regulatory (5%)				500
c. Mobilization/Demobilization (20%)				2,000
TOTAL INDIRECT CAPITAL COSTS				$7,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)				$17,000

TABLE 10-1
ALTERNATIVE 1: NO ACTION
PRELIMINARY COST ESTIMATE
(Continued)

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT ANNUAL COST	LIFE	PRESENT WORTH COSTS	
DIRECT ANNUAL COSTS								
1. Ground Water Sampling/Analysis	Ea	Semi-annual	2	$1,000	$2,000	30	$ 20,500	
TOTAL DIRECT ANNUAL COSTS					$2,000			
TOTAL PRESENT WORTH OF DIRECT ANNUAL COSTS							$ 20,500	
INDIRECT ANNUAL COSTS								
1. Administration	Ea	Annual	1	--	$ 500	30	$ 5,100	
2. Maintenance Reserve & Contingency	Ea	Annual	1	--	500	30	5,100	
TOTAL PRESENT WORTH OF INDIRECT ANNUAL COSTS							$10,000	
TOTAL PRESENT WORTH (CAPITAL + ANNUAL) COSTS								$48,000

10.3 ALTERNATIVE 2: INSTITUTIONAL CONTROLS

10.3.1 DESCRIPTION

Alternative 2 consists solely of institutional control measures designed to isolate receptors from site-based risks. Under this alternative, no actual remedial measures to directly address the contaminated material on the site are implemented; rather, legal controls, such as land use and access restrictions, are employed to minimize the likelihood of receptor contact with contaminated media. Continued monitoring of groundwater as described for Alternative 1 is also included as a part of Alternative 2 to ensure that the risks to human health are being addressed by the institutional controls.

Institutional controls considered feasible for the Sierra Blanca site are access and land use restrictions. Access would be restricted by provision of new site fencing to replace the existing barbed wire fence, plus appropriate signage to warn of the hazards on the site. Land use restrictions would consist of altering the zoning in accordance with the existing City of Carrizozo zoning ordinance to limit permissible uses of the site. Deed notices would consist of recording an appropriate notice with the County of Lincoln to alert parties interested in the property of the hazards contained on the site. These restrictive measures may also be included as elements of other remediation alternatives.

10.3.2 CRITERIA ASSESSMENT

The use of institutional control measures provides a greater degree of protection of human health than the No Action alternative alone, since institutional actions can reduce the potential exposure of receptors. Access and land use restrictions further limit activities on the property which would minimize exposure risks. While some degree of human health protectiveness would be provided by Alternative 2, it would not be protective of the environment since the contamination would remain.

Like Alternative 1, Alternative 2 would not comply with ARARs due to requirements imposed by RCRA Subtitles C and D regarding disposal of mining wastes, and due to New Mexico solid waste regulations. Although reduction in the potential for human exposure would be recognized under this alternative, only limited long-term effectiveness would be provided due to difficulties in enforcement. Additionally, this alternative provides no reduction in the toxicity, mobility, or volume of contaminants at the site. Alternative 2 may also be difficult to implement, since it may be unacceptable to the State of New Mexico and to the residents of Carrizozo.

10.3.3 COST ESTIMATE

Capital expenditures under this alternative include costs for warning signs and additional fencing, and administrative costs for deed notices and zoning restrictions. Additionally, as continued groundwater monitoring is a component of this alternative, the installation of two additional monitoring wells is included. Indirect capital cost items include engineering and design, contingencies, legal, regulatory, and mobilization/demobilization.

Annual costs associated with this remedial action are associated with semi-annual groundwater sampling. Indirect annual costs include administration, contingency, and maintenance reserve.

The present worth cost estimate for Alternative 2 is $119,000 as detailed in Table 10-2. The present worth cost is based on a life of 30 years and an annual interest rate of 9 percent.

TABLE 10-2
ALTERNATIVE 2: INSTITUTIONAL CONTROLS
PRELIMINARY COST ESTIMATE

Description: Access and land use restrictions
Interest Rate: 9%
Level of Accuracy: +50% to -30%

DIRECT CAPITAL COSTS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST
1. Access Restriction				
a. Fencing & Signs	L.F.	2,510	$12	$30,000
2. Land Use Restrictions				
a. Deed Notices	L.S.	1	1,000	1,000
b. Zoning Restriction	L.S.	1	1,000	1,000
3. Install Additional Monitoring Wells	Ea	2	5,000	10,000
TOTAL DIRECT CAPITAL COSTS				$42,000
INDIRECT CAPITAL COSTS				
1. Engineering & Design (7%)				$2,900
2. Contingency (15%)				6,300
3. Other Indirect Costs				
a. Legal (5%)				2,800
b. Regulatory (5%)				2,800
c. Mobilization/Demobilization (10%)				5,500
TOTAL INDIRECT CAPITAL COSTS				$20,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)				$62,000

TABLE 10-2
ALTERNATIVE 2: INSTITUTIONAL CONTROLS
PRELIMINARY COST ESTIMATE
(Continued)

DIRECT ANNUAL COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT ANNUAL COST	LIFE	PRESENT WORTH COSTS	
1. Ground Water Sampling/Analysis	Ea	Semi-annual	2	$1,000	$2,000	30	$20,500	
TOTAL DIRECT ANNUAL COSTS					$2,000			
TOTAL PRESENT WORTH OF DIRECT ANNUAL COSTS							$20,500	
INDIRECT ANNUAL COSTS								
1. Administration	Ea	Annual	1	--	$ 500	30	$ 5,100	
2. Maintenance Reserve & Contingency	Ea	Annual	1	--	500	30	5,100	
TOTAL PRESENT WORTH OF INDIRECT ANNUAL COSTS							$10,000	
TOTAL PRESENT WORTH (CAPITAL + ANNUAL) COSTS								$93,000

10.4 ALTERNATIVE 3: CEMENT SOLIDIFICATION/ON-SITE DISPOSAL

10.4.1 DESCRIPTION

Alternative 3 involves treatment of the contaminated waste material on the Sierra Blanca site, followed by on-site disposal. Treatment would be accomplished by a fixation process using Portland cement to solidify the waste material. Non-leachable wastes (as per TCLP results) present on the site would not require treatment. After treatment, both wastes types would be disposed in an on-site landfill. A schematic of Alternative 3 is shown on Figure 10-1.

As discussed in Section 9, fixation is the only suitable treatment technology that is feasible for the wastes, and the cement solidification process appears to be the most appropriate fixation process. Results of ongoing bench scale studies of both Portland cement solidification and chemical neutralization fixation processes will likely confirm this assumption; however, in the event that neutralization is found to be more effective, neutralization would be implemented in lieu of cement solidification.

Treatment of Sierra Blanca waste material is applicable to only the leachable fraction, i.e., that portion of the waste which did not pass the TCLP tests, and which therefore would be expected to leach lead to the environment. The wastes which failed the TCLP tests are the material piles and the tank sediments. Contaminated surficial soils and soils within the discharge pits successfully passed the TCLP tests (although they remain hazardous due to other potential receptor exposure pathways besides leaching, such as ingestion). This non-leachable fraction, thus, does not require further treatment; however, the non-leachable wastes must be disposed in an acceptable manner. Minimum standards for land disposal of the non-leachable wastes are considered to be those contained in RCRA Subtitle D. After fixation treatment, the leachable wastes will be rendered non-leachable, and may then also be disposed in accordance with RCRA Subtitle D

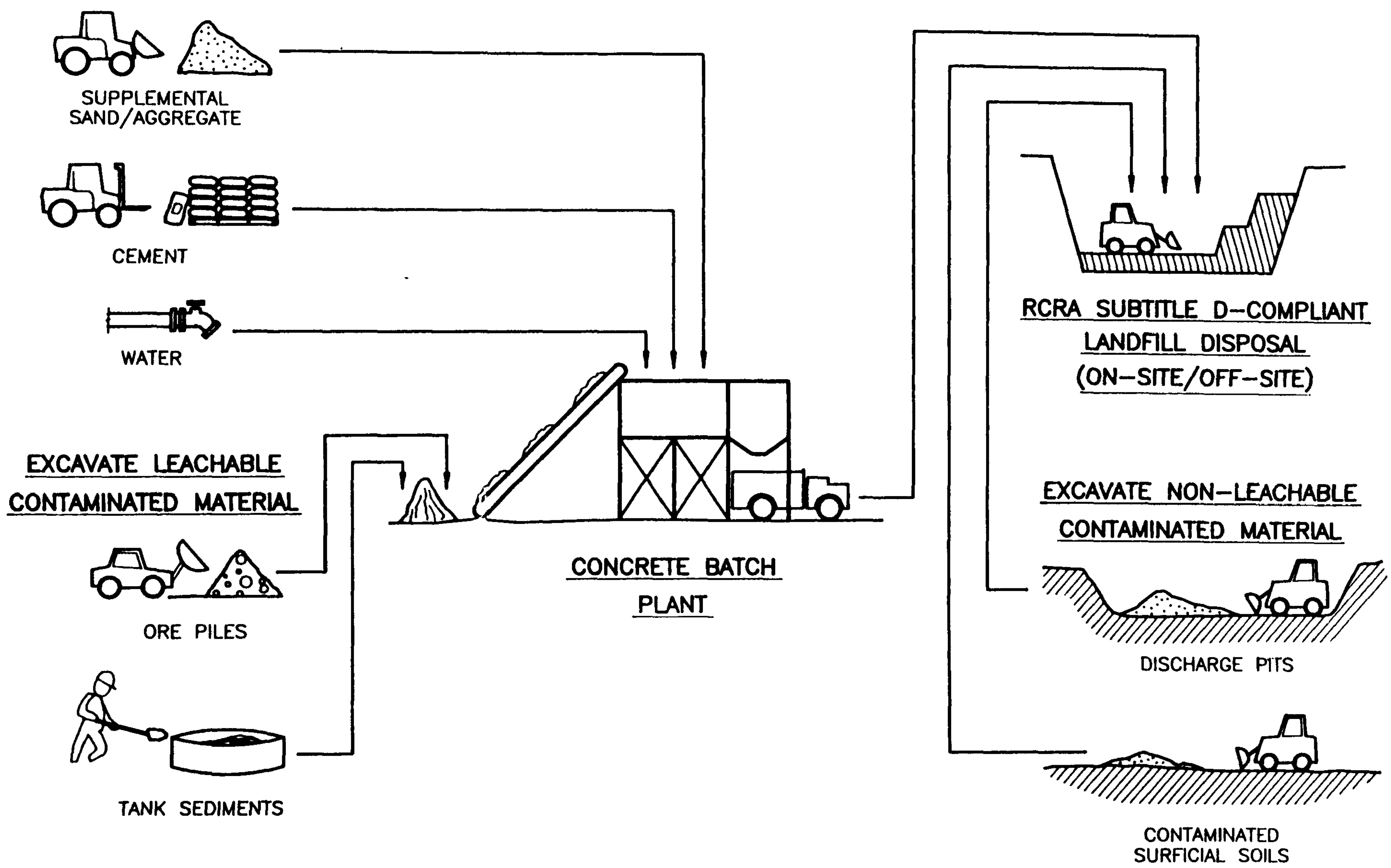


FIGURE 10-1
CEMENT SOLIDIFICATION FIXATION TREATMENT SCHEMATIC

CAMP DRESSER & McKEE INC.

(municipal and industrial solid waste) standards. A summary of both the leachable and non-leachable contaminated material quantities on the Sierra Blanca site are provided on Table 10-3.

Final disposal of the treated wastes (leachable fraction) and the untreated wastes (non-leachable fraction) under Alternative 3 would be on-site. Construction standards for the on-site landfill would be determined during the remedial design phase prior to implementation, and would be developed in accordance with Federal and State ARARs.

RCRA Subtitle D-compliant landfills are designed on a site-specific basis, and for this site it is assumed that appropriate controls would be provided by a simple subgrade, waste material repository, and soil cap. No impermeable liner in the landfill should be necessary as the treated waste material would be non-leachable, and the landfill could be constructed well above seasonal high groundwater levels. Additionally, application of the Hydrologic Evaluation for Landfill Performance (HELP) computer model (Section 2.5.1) predicts minimal percolation of precipitation to groundwater at the site. The landfill cap would consist of a layer of topsoil to prevent access to the contaminated material within the landfill. The cap will be graded to promote runoff of stormwater, and external storm water controls, such as drainage swales, would be constructed to keep storm water away from the landfill. Monitoring wells would also be provided around the landfill to verify that leaching of contaminants is not occurring based on periodic sampling. A representative section for a RCRA Subtitle D-compliant landfill considered appropriate for the Sierra Blanca site is depicted on Figure 10-2.

Implementation of Alternative 3 would consist of leasing a standard portable concrete mixer and setting it up on the site. Portland cement of a type to be determined based on bench scale tests would be purchased and stockpiled on-site, together with any supplemental sand or aggregate required to achieve the mix design. The contaminated material piles and tank sediments would be excavated and discharged

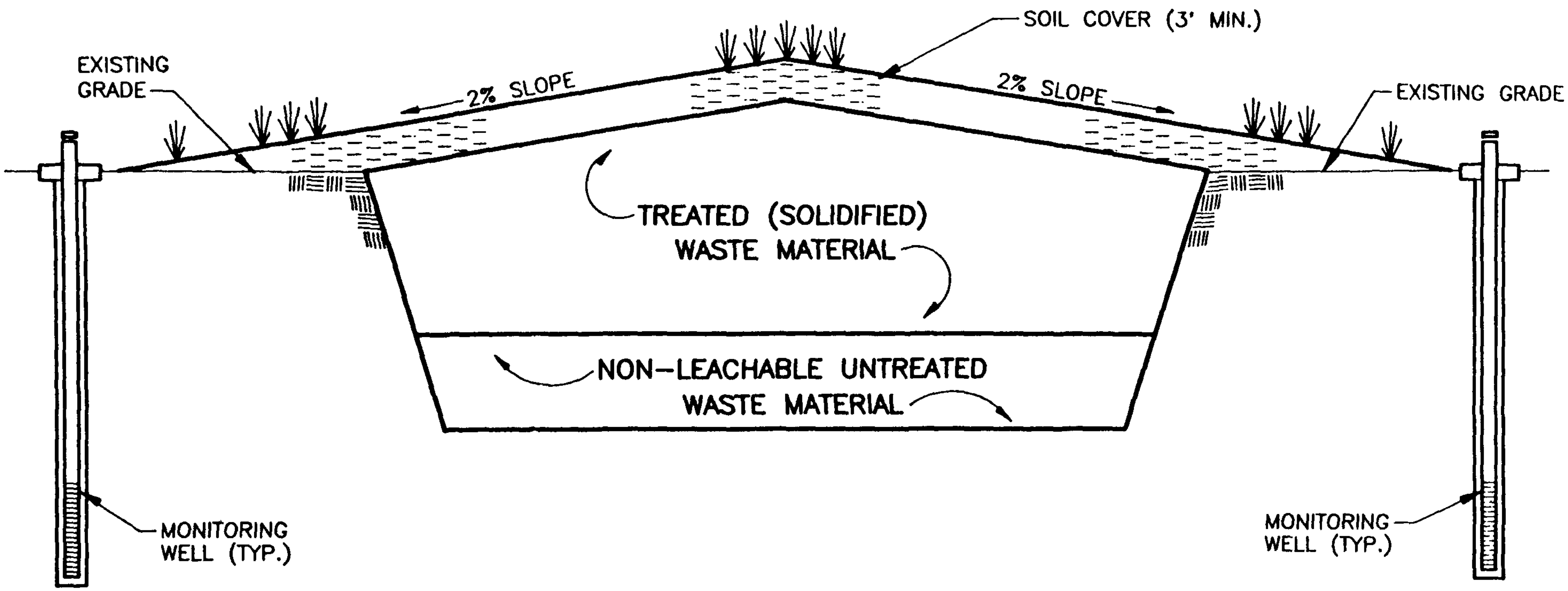
TABLE 10-3

SIERRA BLANCA SITE
CONTAMINATED WASTE MATERIAL QUANTITIES

Source Area	Est. Vol. (C.Y.)	Estimated S.G.	Mass (T)
1. LEACHABLE MATERIAL*			
Material Piles	182	3.00	460
Tank Sediments**	43	2.65	96
Subtotal	225		556
2. NON-LEACHABLE MATERIAL*			
Discharge Pits and Surficial Soils	345	2.65	770
TOTAL	570		1,326

* Per TCLP test (see Section 4.6)
** Includes cinder block trench sediments

C.Y. = cubic yard
S.G. = specific gravity
T = ton



NOTE: THIS CROSS-SECTION ILLUSTRATES THE ALTERNATIVE 3 ON-SITE DISPOSAL AREA IN DISCHARGE PIT 1.

FIGURE 10-2

ON-SITE LANDFILL REPRESENTATIVE SECTION

into the cement mixer where the material would be mixed with Portland cement, water, and any supplemental sand or aggregate required. The resulting concrete mixture would then be deposited in the on-site landfill (Discharge Pit 1). Non-leachable contaminated surficial soils and sediments within the contaminated discharge pits would be excavated and deposited directly without treatment. The discharge pit would then be capped.

10.4.2 CRITERIA ASSESSMENT

Alternative 3 would be highly protective of human health and the environment, since the wastes would be treated to the extent practicable. Additionally, this alternative would achieve compliance with all ARARs. Long-term effectiveness and permanence would also be achieved. Durability tests are being conducted on the solidified material as part of the bench scale treatability tests. This information will be helpful in further evaluating the long term effectiveness of this option.

Alternative 3 would reduce the toxicity and mobility of the wastes through treatment; however, the volume of the wastes would not be reduced. Implementation of this alternative should provide a high degree of short-term effectiveness, provided appropriate precautions and control measures such as dust control are instituted during the remediation phase.

Implementation of this alternative is possible without undue technical or administrative difficulty.

10.4.3 COST ESTIMATE

Capital expenditures under this alternative include costs for leasing a cement mixer, solidification materials costs, and remediation site work. Additionally, as continued groundwater monitoring is a component of this alternative, the installation of two additional monitoring wells is included. Indirect capital cost items include engineering and design, contingencies, legal, regulatory, and mobilization/demobilization.

Annual costs associated with this remedial action are associated with annual groundwater sampling for the first five years after remedial site work, then continued groundwater sampling once every five years for twenty five years. This lesser amount of long-term groundwater monitoring than assumed for Alternatives 1 and 2 is considered for Alternative 3 since the contaminated source material will be remediated under Alternative 3. Indirect annual costs include administration, contingency, and maintenance reserve.

The present worth cost estimate for Alternative 3 is $79,000 as detailed in Table 10-4. The present worth cost is based on a life of 30 years and an annual interest rate of 9 percent.

10.5 ALTERNATIVE 4: CEMENT SOLIDIFICATION/OFF-SITE MUNICIPAL LANDFILL DISPOSAL

10.5.1 DESCRIPTION

Alternative 4 involves cement solidification fixation treatment of the leachable fraction of the Sierra Blanca waste material, followed by transportation together with excavated non-leachable wastes to a suitable off-site RCRA Subtitle D-compliant landfill for final disposal. Alternative 4 is similar to Alternative 3, except that final disposal of the wastes would be in an off-site landfill. As discussed in Section 9, one qualified off-site landfill which appears willing to accept the wastes is located 160 miles from the Sierra Blanca site near Albuquerque. Transportation of the wastes would be accomplished in standard public highway-approved bulk carrier trucks, of approximately 40,000 lb. capacity, which would be covered to prevent generation of airborne contaminants. After disposal of the wastes in the landfill, management of the wastes would become the

TABLE 10-4
ALTERNATIVE 3: CEMENT SOLIDIFICATION / ON-SITE DISPOSAL
PRELIMINARY COST ESTIMATE

Description: Excavate waste material, solidify leachable fraction with Portland cement, dispose on-site
Interest Rate: 9%
Level of Accuracy: +50% to -30%

DIRECT CAPITAL COSTS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST
1. Cement Mixer Lease	Month	1	$5,000	$5,000
2. Purchase Portland Cement	Bags	1,350	5	6,800
3. Excavate Leachable Waste Material	C.Y.	225	16	3,600
4. Solidify Leachable Material with Cement; Place in On-Site Landfill	C.Y.	225	30	6,800
5. Excavate Non-Leachable Material; Place Directly into On-Site Landfill	C.Y.	178*	20	3,600
6. Earthwork/Grading	L.S.	1	5,000	5,000
7. Install Additional Monitoring Wells	Ea	2	5,000	10,000
TOTAL DIRECT CAPITAL COSTS				$41,000

INDIRECT CAPITAL COSTS

1. Engineering & Design (20%)	$ 8,200
2. Contingency (15%)	6,200
3. Other Indirect Costs	
a. Legal (5%)	2,100
b. Regulatory (5%)	2,100
c. Mobilization/Demobilization (10%)	4,100
TOTAL INDIRECT CAPITAL COSTS	$23,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)	$64,000

* Material in discharge pit 1 will not be excavated since discharge pit 1 will be the on-site landfill location.

TABLE 10-4
ALTERNATIVE 3: CEMENT SOLIDIFICATION / ON-SITE DISPOSAL
PRELIMINARY COST ESTIMATE
(Continued)

DIRECT ANNUAL/PERIODIC COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT PERIODIC COST	LIFE	PRESENT WORTH COSTS	
1. Ground Water Sampling/Analysis	Ea	Semi-annual*	--	$1,000	$1,000	30	$5,000	
TOTAL DIRECT PERIODIC COSTS					$1,000			
TOTAL PRESENT WORTH OF DIRECT PERIODIC COSTS							$5,000	
INDIRECT ANNUAL/PERIODIC COSTS								
1. Administration	Ea	Annual	1	--	$ 500	30	$ 5,100	
2. Maintenance Reserve & Contingency	Ea	Annual	1	--	500	30	5,100	
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS							$10,000	
TOTAL PRESENT WORTH (CAPITAL + ANNUAL/PERIODIC) COSTS								$79,000

* Semi-Annual groundwater sampling for five years, then once every five years for 25 years.

responsibility of the landfill operator. For this reason, the operator has stated that the landfill would accept the wastes only if approved by EPA and the State of New Mexico, and only if the wastes are certified as non-hazardous as per RCRA.

10.5.2 CRITERIA ASSESSMENT

As with Alternative 3, Alternative 4 would be highly protective of human health and the environment since the wastes would be treated, and compliance with ARARs would be achieved. A high degree of long-term effectiveness and permanence would be provided since an appropriate municipal landfill is frequently monitored. Additionally, this alternative would achieve a high degree of permanence.

Alternative 4 would reduce the toxicity and mobility of the wastes through treatment. Implementation of this alternative should provide a reasonable degree of short-term effectiveness, provided appropriate precautions and control measures are instituted during the remediation phase. These measures would be those that minimize or prevent exposure hazards to on-site workers and nearby residents during remediation activities.

10.5.3 COST ESTIMATE

Capital costs for Alternative 4 include excavation of the contaminated material and associated site grading, on-site cement solidification fixation treatment of the leachable fraction of the wastes, and transportation of the material to a municipal landfill. Estimated tipping fees required by the landfill are also included. Additionally, as continued groundwater monitoring is a component of this alternative, the installation of two additional monitoring wells is included. Indirect capital cost items include engineering and design, contingencies, legal, regulatory, and mobilization/demobilization.

Annual costs associated with this remedial action are associated with annual groundwater sampling for the first five years after remedial site work, then continued groundwater sampling once every five years for twenty five years. This lesser amount of long-term groundwater monitoring than assumed for Alternatives 1 and 2 is considered for Alternative 4 since the contaminated source material will be remediated and removed from site under Alternative 4. Indirect annual costs include administration, contingency, and maintenance reserve.

The present worth cost estimate for Alternative 4 is $235,000 as detailed in Table 10-5. The present worth cost is based on a life of 30 years and an annual interest rate of 9 percent.

10.6 ALTERNATIVE 5: OFF-SITE MUNICIPAL AND HAZARDOUS WASTE LANDFILL DISPOSAL

10.6.1 DESCRIPTION

In lieu of treatment of the leachable fraction of the Sierra Blanca waste material, an alternate approach would be to dispose of it in a hazardous waste landfill. Alternative 5, therefore, consists of excavating the leachable wastes and transporting them without treatment to a suitable hazardous waste landfill. Because there is no requirement to dispose of the non-leachable wastes in a hazardous waste landfill, these wastes would be excavated, kept segregated from the leachable wastes, and transported to a municipal landfill for final disposal.

Suitable hazardous waste landfills are available in Nevada, Utah, and Colorado. A preliminary estimate of hazardous waste landfill disposal costs was developed based on the Colorado facility, as it is the closest to the Sierra Blanca site. When contacted, the hazardous waste landfill in Colorado expressed an interest in accepting the wastes and provided a budget estimate for tipping fees.

TABLE 10-5
ALTERNATIVE 4: CEMENT SOLIDIFICATION / OFF-SITE MUNICIPAL LANDFILL DISPOSAL
PRELIMINARY COST ESTIMATE

Description: Excavate waste material, solidify leachable fraction with Portland cement, transport to and dispose in municipal landfill
Interest Rate: 9%
Level of Accuracy: +50% to -30%

DIRECT CAPITAL COSTS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST
1. Cement Mixer Lease	Month	1	$5,000	$5,000
2. Purchase Portland Cement	Bags	1,350	5	6,800
3. Excavate Waste Material	C.Y.	570	16	9,100
4. Solidify Leachable Material with Cement	C.Y.	225	30	6,800
5. Transport to Landfill*	$/ton-mile (160 miles)	1,882*	0.20	60,200
6. Municipal Landfill Tipping Fee	$/ton	1,882	15	28,200
7. Earthwork/Grading	L.S.	1	5,000	5,000
8. Lead & TCLP Analyses	Ea	20	1,200	24,000
9. Install Additional Monitoring Wells	Ea	2	5,000	10,000
TOTAL DIRECT CAPITAL COSTS				$155,000
INDIRECT CAPITAL COSTS				
1. Engineering & Design (7%)				$ 10,900
2. Contingency (15%)				23,300
3. Other Indirect Costs				
a. Legal (5%)				7,800
b. Regulatory (5%)				7,800
c. Mobilization/Demobilization (10%)				15,500
TOTAL INDIRECT CAPITAL COSTS				$ 65,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)				$220,000

* Assumes landfill in Albuquerque

Note: It is assumed that the mass of the solidified wastes would approximately double after treatment
Total mass = 410T (leachable fraction) x 2 + 817T (non-leachable fraction) = 1,637T

TABLE 10-5
ALTERNATIVE 4: CEMENT SOLIDIFICATION / OFF-SITE MUNICIPAL LANDFILL DISPOSAL
PRELIMINARY COST ESTIMATE
(Continued)

DIRECT ANNUAL/PERIODIC COSTS

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT PERIODIC COST	LIFE	PRESENT WORTH COSTS	
1. Ground Water Sampling/Analysis	Ea	Semi-annual*	--	$1,000	$1,000	30	$5,000	
TOTAL DIRECT PERIODIC COSTS					$1,000			
TOTAL PRESENT WORTH OF DIRECT PERIODIC COSTS							$5,000	
INDIRECT ANNUAL/PERIODIC COSTS								
1. Administration	Ea	Annual	1	--	$ 500	30	$ 5,100	
2. Maintenance Reserve & Contingency	Ea	Annual	1	--	500	30	5,100	
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS							$10,000	
TOTAL PRESENT WORTH (CAPITAL + ANNUAL/PERIODIC) COSTS								$235,000

* Semi-Annual groundwater sampling for five years, then once every five years for 25 years.

10.6.2 CRITERIA ASSESSMENT

Alternative 5 would be protective of human health and the environment since the contaminated material would be removed from site and safely disposed of. Compliance with ARARs would be achieved as disposal of the wastes would be permitted under current regulations. A similar degree of long-term effectiveness and permanence would be provided with this alternative compared to on-site landfill disposal. Although treatment would be provided prior to disposal in an on-site landfill, the continuous monitoring and active waste management present in a permitted hazardous waste landfill should provide a comparable level of protectiveness. The long-term effectiveness and permanence of off-site hazardous waste landfill disposal would be less than treatment and disposal in a municipal landfill, since treatment of the wastes would be provided prior to disposal in the municipal landfill. Additionally, the level of waste management and waste monitoring provided is comparable at both facilities. This alternative would achieve a high degree of permanence since the wastes are removed from the Sierra Blanca site.

Alternative 5 would reduce the mobility of the wastes as a result of disposal in a hazardous waste landfill. However, the toxicity and volume of the wastes would not be affected. Implementation of this alternative should provide a reasonable degree of short-term effectiveness, provided the appropriate precautions and control measures are instituted during the remediation phase involving excavation of the contaminated material.

10.6.3 COST ESTIMATE

Capital costs for Alternative 5 include excavation of the contaminated material and associated site work, transportation of the leachable fraction of the wastes to a hazardous waste landfill, and transportation of the non-leachable fraction to a municipal landfill. Confirmation of total waste removal would be conducted by analyses of lead in post-remediation surficial soils samples. Additionally, as continued groundwater monitoring is a component of this alternative, the installation of two additional monitoring wells is included. Indirect capital cost items include engineering and design, contingencies, legal, regulatory, and mobilization/demobilization.

Annual costs associated with this remedial action are associated with annual groundwater sampling for the first five years after remedial site work, then continued groundwater sampling once every five years for twenty five years. This lesser amount of long-term groundwater monitoring than assumed for Alternatives 1 and 2 is considered for Alternative 5 since the contaminated source material will be remediated and removed from site under Alternative 5. Indirect annual costs include administration, contingency, and maintenance reserve.

The present worth cost estimate for Alternative 5 is $344,000 as detailed in Table 10-6. The present worth cost is based on a life of 30 years and an annual interest rate of 9 percent.

Table 10-7 provides a cost summary of the five remediation alternatives for the Sierra Blanca Operable Unit (OU2) of the Cimarron Mining Corporation NPL site.

TABLE 10-6
ALTERNATIVE 5: OFF-SITE MUNICIPAL AND HAZARDOUS WASTE LANDFILL DISPOSAL
PRELIMINARY COST ESTIMATE

Description: Excavate waste material, dispose leachable fraction in hazardous waste landfill, dispose non-leachable fraction in municipal landfill
Interest Rate: 9%
Level of Accuracy: +50% to -30%

DIRECT CAPITAL COSTS

COST COMPONENT	UNIT	QUANTITY	UNIT COST	CAPITAL COST
1. Excavate Waste Material	C.Y.	570	$16	$9,100
2. Transport Leachable Fraction to Hazardous Waste Landfill*	$/ton-mile (500 miles)	556	0.20	55,600
3. Hazardous Waste Landfill Tipping Fee	$/ton	556	206	114,500
4. Transport Non-Leachable Fraction to Municipal Landfill**	$/ton-mile	770	0.20	24,600
5. Municipal Landfill Tipping Fee	$/ton	770	15	11,500
6. Earthwork/Gradity	L.S.	1	5,000	5,000
7. Lead & TCLP Analysis	Ea	20	1,200	24,000
8. Install Additional Monitoring Wells	Ea	2	5,000	10,000
TOTAL DIRECT CAPITAL COSTS				$244,000

* Assumes Facility in Colorado

** Assumes Facility in Albuquerque

INDIRECT CAPITAL COSTS

1. Engineering & Design (5%)	$ 12,200
2. Contingency (15%)	36,600
3. Other Indirect Costs	
a. Legal (5%)	12,200
b. Regulatory (5%)	12,200
c. Mobilization/Demobilization (5%)	12,200
TOTAL INDIRECT CAPITAL COSTS	$ 85,000
TOTAL CAPITAL COSTS (DIRECT + INDIRECT)	$329,000

TABLE 10-6
ALTERNATIVE 5: OFF-SITE MUNICIPAL AND HAZARDOUS WASTE LANDFILL DISPOSAL
PRELIMINARY COST ESTIMATE
(Continued)

COST COMPONENT	UNIT	FREQUENCY	QUANTITY (PER YR)	UNIT COST	DIRECT PERIODIC COST	LIFE	PRESENT WORTH COSTS	
DIRECT ANNUAL/PERIODIC COSTS								
1. Ground Water Sampling/Analysis	Ea	Semi-annual*	--	$1,000	$1,000	30	$5,000	
TOTAL DIRECT PERIODIC COSTS					$1,000			
TOTAL PRESENT WORTH OF DIRECT PERIODIC COSTS							$5,000	
INDIRECT ANNUAL/PERIODIC COSTS								
1. Administration	Ea	Annual	1	--	$ 500	30	$ 5,100	
2. Maintenance Reserve & Contingency	Ea	Annual	1	--	500	30	5,100	
TOTAL PRESENT WORTH OF INDIRECT ANNUAL/PERIODIC COSTS							$10,000	
TOTAL PRESENT WORTH (CAPITAL + ANNUAL/PERIODIC) COSTS								$344,000

* Semi-Annual groundwater sampling for five years, then once every five years for 25 years.

TABLE 10-7
COST SUMMARY OF REMEDIATION ALTERNATIVES

Alternative	Present Worth Cost
1. No Action	$ 48,000
2. Institutional Controls	93,000
3. Cement Solidification / On-Site Disposal	79,000
4. Cement Solidification / Off-Site Municipal Landfill Disposal	235,000
5. Off-Site Municipal and Hazardous Waste Landfill Disposal	344,000