Final
Omaha Lead Site
Final Feasibility Study

Omaha, Nebraska

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Prepared for:
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Black & Veatch Special Projects Corp.

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List of Acronyms

AES	Architect and Engineering Service
ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BHHRA	Baseline Human Health Risk Assessment
BVSPC	Black and Veatch Special Project Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COPC	Chemicals of Potential Concern
CTE	Central Tendency Exposure
DCHD	Douglas County Health Department
EBL	Elevated Blood Level
EPA	US Environmental Protection Agency
FS	Feasibility Study
HI	Hazard Index
HQ	Hazard Quotient
HEPA	High Efficiency Particulate Air
HEPAVAC	High Efficiency Particulate Air Vacuum Cleaner
HUD	U.S. Department of Housing and Urban Development
IC	Institutional Control
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
IEUBK	Integrated Exposure Uptake Biokinetic Model
LBP	Lead Based Paint
LHCP	City of Omaha Lead Hazard Control Program
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NCP	National Oil & Hazardous Substances Contingency Plan
NDEQ	Nebraska Department of Environmental Quality
NERL	National Exposure Research Laboratory
NPL	National Priorities List
OLS	Omaha Lead Site
OSWER	Office of Solid Waste and Emergency Response
O&M	Operation and Maintenance

ppm	parts per million
PRG	Preliminary Remediation Goal
PRPs	Potentially Responsible Parties
RME	Reasonable Maximum Exposure
RAO	Remedial Action Objectives
RAPMA	Remedial Action Plan Monitoring Act
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TAG	Technical Assistance Group
TBC	To Be Considered
TCLP	Toxic Characteristic Leachate Procedure
TSCA	Toxic Substances and Control Act
USC	United States Code
UTL	Upper Tolerance Limit
XRF	X-Ray Fluorescence
µg/dl	micrograms per deciliter

1.0 Introduction

This Final Feasibility Study (FS) for residential soils remediation at the Omaha Lead Site (OLS), Omaha, Nebraska, (the Site) has been prepared under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The purpose of this Final FS is to assist in the selection of a remedial action for cleanup of contaminated residential soils at the Site. This Final FS has been prepared by Black & Veatch Special Projects Corp. (BVSPC) for the U.S. Environmental Protection Agency (EPA) under the Region 7 Architect & Engineering Services (AES) Contract, Task Order 0031.

1.1 Purpose and Organization of the Report

The FS process is the procedure used to develop and evaluate remedial alternatives prior to selecting a remedial action. The FS report provides documentation for the CERCLA remedy selection process. The goals of this Final FS include the following:

- Providing a framework for evaluating and selecting technologies and remedial actions.
- Satisfying environmental review requirements for a remedial action.
- Complying with administrative record requirements for documentation of remedial action selection.

The purpose of the report is to present and evaluate the remedial alternatives that may be used to address the risks posed by the site. This Final FS, the final remedial investigation, and the risk assessment are significant documents in the Administrative Record which help form the basis from which a Proposed Plan will be developed. This Final FS does not propose a preferred remedial action. In the Proposed Plan, the EPA will indicate which type of cleanup action it prefers and seek public input on what types of cleanup actions should take place. Once the public has had an opportunity to review and comment on the Proposed Plan, a final record of decision (ROD) will be issued by the EPA which formally selects the final remedial action to be conducted at the OLS.

In addition to this introduction, this report is organized into the following sections:

- Section 2 - Potential Applicable or Relevant and Appropriate Requirements
- Section 3 - Identification and Screening of Technologies

- Section 4 - Identification and Screening of Applicable Technologies and Process Options
- Section 5 - Development of Alternatives
- Section 6 - Detailed Evaluation of Remedial Alternatives
- Section 7 - Comparative Analysis of Alternatives

1.2 Background Information

1.2.1 Site Location and Description

The site is comprised of numerous residences and residential-type properties which have been contaminated as a result of air emissions from lead smelting and refining industrial operations (Ref. 1). The ASARCO facility, which operated as a lead smelter/refinery from the 1870s to 1997, was located at 500 Douglas Street at the intersection of I-480 and Abbott Drive in the eastern portion of Omaha, Nebraska or more specifically, at 41° 15' 64" north latitude and 95° 55' 47" west longitude (Ref. 1). The ASARCO property was cleaned up under the State of Nebraska Remedial Action Plan Monitoring Act (RAPMA) program. The former Gould facility, located at 555 Farnam Street, operated as a secondary lead smelter and was acquired and cleaned up by Douglas County, and is now a County park. In addition, lead-based paint and leaded fuel emissions, which would be expected to be found in urban areas such as Omaha, may have contributed to the soil contamination to some extent. Land use within a 4-mile radius of the site area is residential, commercial, and industrial (Ref. 5).

The original boundaries of the OLS focus area were established at the time the Site was listed on the EPA National Priorities List (NPL). During the remedial investigation (RI) in 2004 (Ref. 21), the OLS focus area was expanded to include an area south of L Street to the Sarpy County Line (Harrison Street), an area north of Ames Avenue to Redick Avenue, and an area to the west of 45th Street. The focus area was expanded in 2008 to include an area north to Read Street and west to 56th Street. A map of the present final focus area is presented in Figure 1-1.

1.2.2 Operational History and Waste Characteristics

The ASARCO facility conducted lead refining operations from the early 1870s until 1997. The ASARCO facility was located on approximately 23 acres on the west bank of the Missouri River in downtown Omaha. The former lead refinery processed lead bullion containing recoverable amounts of metals, including gold, silver, antimony, and bismuth.

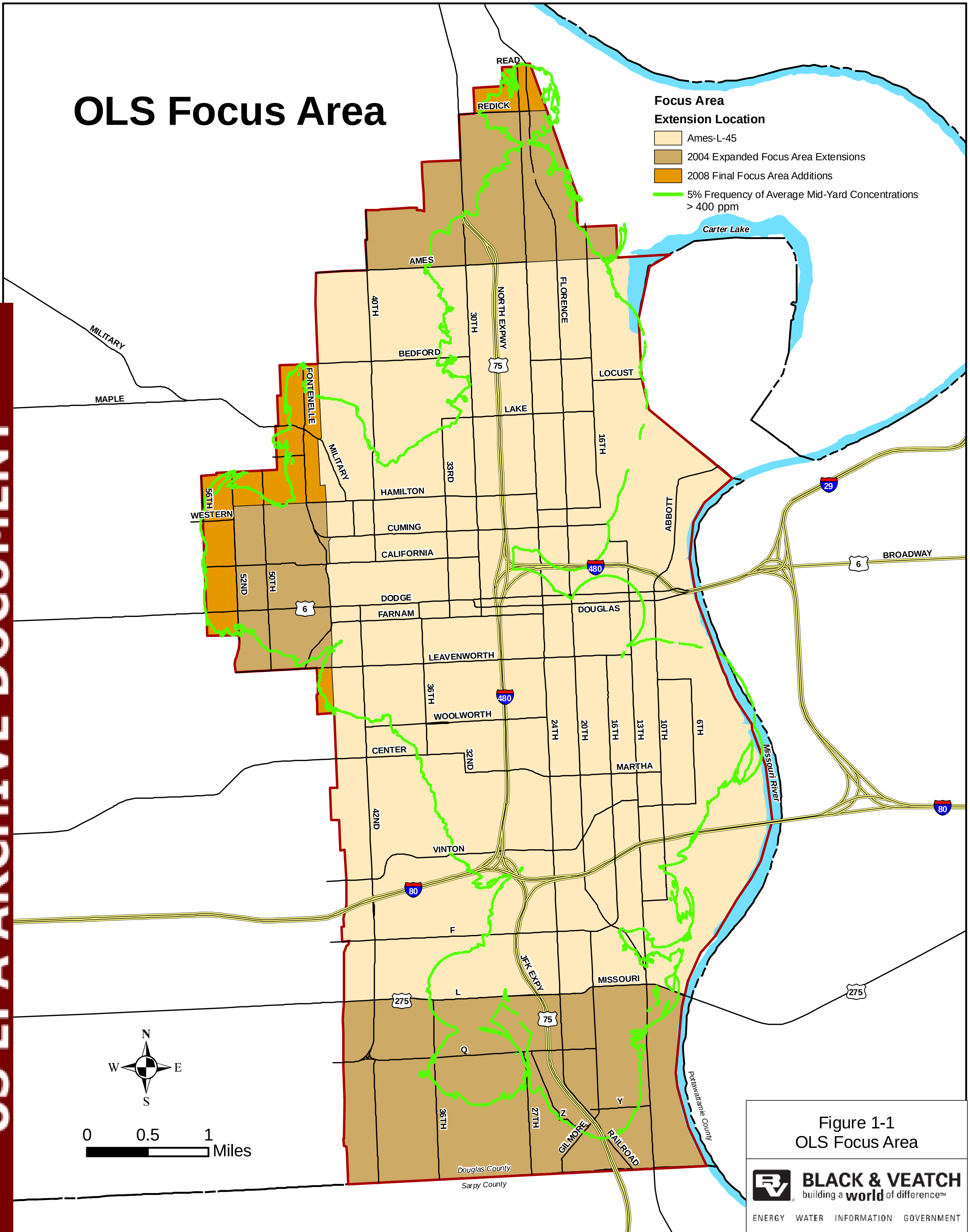

Figure 1-1
OLS Focus Area

The refinery process used the traditional pyrometallurgical process, including the addition of metallic and non-metallic compounds to molten lead, and separation of the lead from the other metals and removing impurities. Refined lead and specialty metal by-products such as antimony-rich lead, bismuth, dore (silver-rich material), and antimony oxide were produced at the facility.

The fully refined lead was formed into 100-pound castings or 1-ton blocks. The metal was then shipped to industries requiring lead to produce various products. During the operational period, lead, cadmium, zinc, and arsenic were emitted into the atmosphere through smoke stacks. The pollutants were transported downwind in various directions and deposited on the ground surface due to the combined process of turbulent diffusion and gravitational settling.

A secondary lead smelter was operated at 555 Farnam Street in Omaha from the early 1950s until closing in 1982. Aaron Ferer & Sons, Co. constructed this facility to smelt lead batteries and other scrap lead. The facility was sold to a predecessor of Gould National Batteries in 1963 that operated the facility until closing. Several other businesses in the Omaha area used lead in their manufacturing process.

In 1998 the Omaha City Council solicited assistance from the EPA in addressing problems with lead contamination in the Omaha area. The EPA initiated the process to investigate the lead contamination in the area under the authority of CERCLA in 1999.

The EPA began sampling residential properties used for licensed child-care services in March 1999. Between March 1999 and February 2009, surface soil samples were collected from 37,076 residential properties. In 2004, BVSPC prepared a Remedial Investigation/Feasibility Study (RI/FS) Report to address the soil contamination at the site. Following preparation of the RI/FS, EPA issued an interim ROD on December 15, 2004. The selected remedy in the interim ROD required the excavation and removal of lead-contaminated soils, backfilling the excavated areas to original grade with clean topsoil, and restoring a grass lawn. Generally the properties that were designated for an interim response included:

- Any residential-type property where at least one non-foundation soil sample exceeded 800 parts per million (ppm) lead;
- Residences with any non-foundation sample exceeding 400 ppm lead where a child identified with an elevated blood lead level resides; and
- Child-care facilities and other high child-impact areas with any non-foundation sample exceeding 400 ppm lead.

When a remedial response action was initiated at a property meeting any of the above criteria, soil excavation and replacement were performed in all portions of the property where soils concentrations of 400 ppm or higher were detected, including drip zones. As of February 2009, the EPA has completed soil remediation at 4,611 properties at the OLS.

The interim remedy now underway also includes stabilization of deteriorating exterior lead based paint (LBP) in cases where the continued effectiveness of the remedy is threatened because remediated soils could become recontaminated by small paint particles mixing with soil. Currently, lead levels in exterior mid-yard samples must exceed the soil action levels specified in the interim ROD for the property to be potentially eligible for stabilization of deteriorating LBP. If the soil action levels are exceeded at a property, then structures on that property are potentially eligible for stabilization of deteriorating LBP based upon the results of a LBP assessment. The Interim ROD did not specify quantitative criteria for deteriorated LBP that would be used as an action level to determine eligibility for paint stabilization. Instead, EPA intended that the criteria to be used to determine eligibility for LBP stabilization would be developed during implementation of the interim remedial action. Until criteria are finalized, properties are being prioritized for LBP stabilization based upon the most severe deteriorating LBP problem detected during the screening and the presence of children under the age of seven. As of February 2009, LBP assessments had been performed on structures at 2,894 properties.

The EPA and the City of Omaha Lead Hazard Control Program (LHCP) are performing paint stabilization at homes where the remediated soils could become recontaminated by deteriorating LBP particles mixing with the soil. Lead-safe procedures are used to prepare the deteriorated surfaces, followed by priming and painting of all previously painted surfaces on eligible structures. Yard surfaces are vacuumed using high efficiency particulate air (HEPA) fitted equipment to remove visible paint chips following stabilization. The LBP stabilization program was initiated by the Omaha LHCP in 2007. EPA and LHCP continued LBP stabilization in 2008. As of February 2009, EPA contractors had completed LBP stabilization at 930 properties and Omaha LHCP contractors had completed stabilization at 257 properties.

1.2.3 Nature and Extent of Contamination

There are approximately 39,775 properties located in the final OLS focus area that are eligible for sampling. Between March 1999 and February 2009, surface soil samples were collected from 34,565 residential and residential-type properties within the OLS final focus area and 2,511 properties outside the final focus area and analyzed for lead. Jacobs Engineering conducted sampling between March 1999 and July 2000, and since then the sampling has been conducted by BVSPC. The properties sampled are relatively evenly distributed throughout the final focus area at the site with elevated lead concentrations in surface soil throughout the study area. At the time this Final FS Report was prepared, soil samples had not been collected from the western and northern areas which were added to the expanded focus area in 2008 to become the final focus area.

Of the 37,076 properties sampled in the investigation, 8,552 properties had at least one non-foundation sample with a total lead concentration between 400 ppm and 800 ppm and 4,144 properties had at least one non-foundation sample with a total lead concentration greater than or equal to 800 ppm, which is the lead concentration that triggers a response under the Interim ROD. A total of 4,611 properties have been remediated as of February 2009. Of the sampled properties, 8,085 properties [(8,552 + 4,144) – 4,611] with lead concentrations above 400 ppm remain to be remediated if a final action level of 400 ppm is selected by EPA in the Final ROD. Of the 5,210 properties that have not been sampled, it is estimated an additional 1,881 properties will need to be remediated if an action level of 400 ppm is selected by EPA based on the percentage of sampled properties that contained lead concentrations above 400 ppm.

Data from the 2004 RI Report indicated that the highest lead concentrations were expected to be along the direction of prevailing wind. The Final RI results appear to support this assertion because most of the homes with soil-lead concentrations exceeding 400 ppm are concentrated along the prevailing wind directions. An analysis of the Final RI results is presented in Section 5.0 of the Final RI report (Ref 31). An earlier investigation (Ref. 29) of subsurface soil-lead concentrations indicated that the lead has not generally migrated beyond the top 2-12 inches of soil. Conditions within the soil are not conducive to further migration.

1.2.4 Contaminant Fate and Transport

Early investigations at the OLS found evidence of high lead concentrations in surface soils along the corridors of the prevailing wind currents that pass through downtown Omaha. At the same time, two industrial properties on the east side of downtown Omaha were being investigated as possible sources of the contamination. The conclusions of these investigations demonstrated that the contamination was deposited from air currents transporting industrial emissions generated at the east edge of downtown, along the Missouri River and traveling outward. These potential sources have been closed and no other potential industrial sources of lead-contamination that could have widespread influence have been identified to date.

Investigations conducted at the site have studied potential migration of lead contamination from surface to subsurface soils. Investigations of soil chemistry and lead concentrations in subsurface soils at the site have indicated that the lead contamination at the site is concentrated in the top 12 inches of soil. Lead was detected in 511 surface samples where subsurface samples were collected at the same location. The number of samples in which lead was detected decreased at each downward interval. The average, maximum, and median lead concentrations also decreased as depth increased, indicating only minor migration downward from surface soils. These results led the EPA to discontinue depth sampling.

Additional migration of contaminants on the site may occur through wind, surface water erosion and human activity.

1.2.5 Baseline Risk Assessment

The BHHRA for the OLS was prepared by the Syracuse Research Corporation (Ref. 30). The purpose of the BHHRA is to characterize the risks to area residents, both now and in the future, from site-related contaminants present in environmental media, assuming that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. The results of the final assessment are intended to help inform risk managers and the public about potential human risks attributable to site-related contaminants and to help determine where there is a need for action at the site.

The environmental medium of chief concern is surface soil that has been impacted by the wet or dry deposition of metal-containing airborne particulates released from historic lead smelting and refining operations. The human population of chief concern is residents in the area of the site, now or in the future, including both children and adults. Residents might be exposed to smelter-related contaminants in site soils by a number of different pathways, including ingestion, inhalation, and dermal contact with contaminated soil or dust, and ingestion of home-grown produce that may have taken up contaminants from the soil.

Chemicals of Potential Concern (COPCs) are chemicals which exist in the environment at concentration levels that might be of potential health concern to humans and which are or might be derived, at least in part, from site-related sources. The chief COPC at this site is lead. However, several other chemicals were identified that might also be of potential concern to humans, including the following: aluminum, antimony, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, thallium, vanadium, and zinc.

1.2.5.1 Risks from Exposure to Lead

The population of chief concern for lead exposure is young children (age 0-84 months). This is because young children tend to have higher intakes of lead than adults, tend to absorb more lead than adults, and are inherently more sensitive to lead than adults. If environmental exposures to lead in a residential area are acceptable for young children, exposures are usually also acceptable for older children and adults, including pregnant women.

In addition to these exposures to smelter-related releases of lead, children may also be exposed to lead from other sources as well. This includes lead from leaded paint, as well as lead in drinking water and food from grocery stores. Because risk from lead depends on exposure from all of these sources, these exposure pathways are also included in the risk evaluation for lead.

The EPA identified 10 µg/dL as the concentration level at which effects begin to occur that warrant avoidance. For convenience, the probability that an observed blood lead value will exceed 10 µg/dL is referred to as P10. The EPA has established a health-based goal there should be no more than a 5% chance that a child will have a blood lead value above 10 µg/dL. That is, if P10 is ≤ 5%, risks from lead are considered acceptable.

The EPA has developed a mathematical model for evaluating lead risks to residential children. This model is referred to as the Integrated Exposure Uptake Biokinetic Model (IEUBK) model. This model requires as input data on the levels of lead in all potentially contaminated environmental media (soil, dust, water, air, diet) at a specific location, and on the amount of these media taken in (by ingestion or inhalation) by a child living at that location. Given these inputs, the model calculates an estimate of the distribution of blood lead values that might occur in a population of children exposed to the specified conditions, including the value of P10.

The results of the lead risk evaluation include the following key points:

- Of the 28,478 properties evaluated, a total of 19,445 homes (68%) are predicted to have P10 values at or below the health-based goal of 5%, and 9,033 properties (32%) have values that exceed the goal.
- Of these 9,033 properties, 3,177 have P10 values between 5% and 10%, 3,051 properties have P10 values between 10% and 20%, and 2,805 properties have P10 values greater than 20%.
- The location of properties with P10 values greater than the health-based goal of 5% were widespread across the OLS final focus area and were frequently found within all zip codes, with the exception of 68117 (which only had 2 properties).

These results indicate that a number of homes or parcels within the final focus area have soil lead levels that are of potential health concern to children who may reside there, now or in the future.

1.2.5.2 Risks from Non-Lead Contaminants

Although lead was the primary contaminant released to the environment from the historic operation of the smelters in the OLS, other metal and metalloid contaminants may also have been released. Exposure of residents (adults and children) to non-lead chemicals of potential concern in site soils and dusts was evaluated on a property-by-property basis.

Exposure was calculated in accord with standard equations recommended by EPA. In brief, the amount of chemical ingested or absorbed per day from each medium was calculated from information on the concentration of the chemical in the medium and the amount of medium that is ingested or contacted. Because there are usually differences between individuals in the level of exposure due to differences in intake rates, body weights, exposure frequencies, and exposure durations, calculations were performed for individuals that are "average" or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range (e.g., the 95th percentile). These two exposure estimates are referred to as Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME), respectively. Values of CTE and RME parameters for soil and dust were in accord with standard default values recommended by EPA for evaluation of residents.

The estimated non-cancer risks from most COPCs in surface soils for residential CTE and RME scenarios, including both children (age 0-6 years) and adults (age 7-30 years), are below a level of potential concern (Hazard Quotient (HQ) $\leq$ 1) for both child and adult residents. An exception is arsenic, which results in an HQ > 1 at about 11 percent of the properties. In addition, there are a small number of properties (< 1 percent of the total) where antimony, mercury and/or thallium yield HQ values above 1. Summation of non-cancer HQ values for chemicals that act on the same target tissue does not result in a substantial increase in non-cancer risk at most properties.

The only COPC at this site that is carcinogenic by the oral or dermal route is arsenic. As seen, estimated cancer risks to CTE residents are within EPA's target risk range (1E-06 to 1E-04) at all properties. Estimated risks to RME residents are also within EPA's target risk range at most properties, although risks exceed 1E-04 at 141 locations (5% of the properties with data). The excess individual lifetime cancer risks at these 141 properties range from 1E-04 to 1E-03.

2.0 Potential Applicable or Relevant and Appropriate Requirements

Pursuant to Section 121(d) of CERCLA, 42 United States Code (U.S.C.) § 9621(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further releases which, at a minimum, assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attain legally applicable or relevant and appropriate federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a state environmental or facility siting law that is more stringent than any federal standard. These are termed as applicable or relevant and appropriate requirements (ARARs). In instances where the remedial actions do not achieve ARARs, the EPA must provide the basis for a waiver. An ARARs waiver is not contemplated for any of the alternatives evaluated in this Final FS.

Applicable requirements are those standards, requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those standards, requirements, criteria, or limitations promulgated under federal or state law that address problems or situations similar to those encountered at the CERCLA site, and therefore, are well suited for that site. Although not legally applicable, these requirements may nonetheless be relevant and appropriate for a particular CERCLA site.

The EPA Region 7 and the State of Nebraska determine which requirements are ARARs by considering the type of remedial actions contemplated, the hazardous substances present, the waste characteristics, the physical characteristics of the site, and other appropriate factors. Only the substantive portions of the requirements need to be followed for on-site actions; CERCLA procedural and administrative requirements require safeguards similar to those provided under other laws. Under Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and the National Oil and Hazardous Substances Contingency Plan (NCP), 40 Code of Federal Regulations (C.F.R.) § 300.400(e), federal state, and local permits are not required for the portions of CERCLA cleanups that are conducted entirely on-site, as long as the actions are selected and carried out in compliance with Section 121 of CERCLA.

There are three types of ARARs. The first type includes chemical-specific requirements. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of these types of ARARs are drinking water standards and ambient water quality criteria. Frequently, the chemical-specific ARARs constitute a basic level of protectiveness for certain hazardous substances. However, for some media, chemical-specific ARARs are not available.

A second type of ARAR includes location-specific requirements that set restrictions on certain types of activities such as those in wetlands, floodplains, and historic sites. Location specific ARARs generally apply to most alternatives under consideration because they are based on the location of the site.

The third type of ARAR includes action-specific requirements. These are technology-based restrictions that are triggered by the type of remedial action under consideration. Examples of action-specific ARARs are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage and disposal. Action-specific ARARs may vary depending on the remedial alternative under consideration. Potential federal and state action-specific ARARs are identified in Section 6 as each alternative is subjected to detailed analysis.

The potential federal and state chemical and location-specific ARARs for the Omaha Lead site Final FS, identified by the EPA, respectively, are presented in Tables 2-1 through 2-4 at the end of this section. These tables cite the requirements identified, state whether the requirements are applicable or relevant and appropriate, or to be considered and summarize the substantive standards to be met.

To be considered (TBC) criteria consist of advisories, criteria, or guidance that were developed by the EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. TBCs do not meet the definition of ARARs, but may be necessary to determine what is protective and are useful when ARARs are not available.

2.1 Potential Chemical-Specific ARARs

The potential chemical-specific ARARs identified for this site relate to protection of human health from exposure to residential property soils because of the unacceptable risks associated with exposure of humans, particularly children under 7 years old, to contaminated soils. As discussed above, the principal contaminant is lead from smelter related operations.

Federal and Nebraska governments have not promulgated standards, requirements, criteria or limitations to control the level of hazardous substances, pollutants, or contaminants in the soil at residential properties. Therefore, the alternatives evaluated for this FS do not have chemical-specific ARARs for contaminated soils in residential properties. However, the risk assessment and other federal and state guidance are available to evaluate each alternative for its ability to achieve a basic level of protectiveness for hazardous substances in soil. These documents are listed in Table 2-1 under the category “To Be Considered”. Once contaminated soil has been removed from residential properties and disposed, Nebraska Department of Environmental Quality (NDEQ) Title 117 regulations, “Surface Water Quality Standards”, or similar requirements in the state where disposal occurs, would potentially establish effluent limits on the discharge of pollutants in storm water runoff from the soil disposal area.

The EPA regulations under the Toxic Substances and Control Act (TSCA) concerning lead hazards at residential properties are found in the Code of Federal Regulations (CFR) at 40 CFR Part 745. The regulations contain requirements preventing LBP poisoning in certain residential properties. The regulations define the maximum lead concentrations in dust samples from floors and window sills that present a dust-lead hazard. The regulation specifies that a dust-lead hazard is present in a residential dwelling when the weighted arithmetic mean lead loadings for all single surface or composite samples of floors and interior window sills are equal to or greater than 40 $\mu g/ft^2$ for floors and 250 $\mu g/ft^2$ for interior window sills, respectively.

The regulations also define when a soil lead hazard is present at a residential property. A soil lead hazard is present in a play area when the soil-lead concentration from a composite play area sample of bare soil is equal to or greater than 400 ppm or in the rest of the yard when the arithmetic mean lead concentration from a composite sample is equal to or greater than 1,200 ppm.

The regulations also impose requirements on the seller or lessor of target housing to disclose to the purchaser or lessee the presence of any known lead-based paint hazards, provide available records and reports, and attach specific disclosure and warning language to the sales or leasing contract.

Tables 2-1 and 2-2 identify the potential federal and state chemical-specific ARARs for the Omaha Lead Site.

2.2 Potential Location-Specific ARARs

Physical characteristics of the site may influence the type and location of remedial responses considered for this FS. Potential federal and state location-specific ARARs, presented in Tables 2-3 and 2-4, relate to historic preservation, fish and wildlife coordination procedures, wetlands protection, flood plain protection, and work in navigable waters. Additionally, NDEQ siting statues and location restriction regulations in Title 128 “Nebraska Hazardous Wastes Regulations” and Title 132 “Integrated Solid Waste Management Regulations” may be appropriate for consideration if siting a soil repository is included in a remedial alternative. The final determination of location-specific ARARs will depend upon detailed design and siting decisions made during remedial design.

2.3 Summary of ARARs

Contamination in the residential soils at the Omaha Lead Site poses a potential threat to human health. CERCLA requires that any remedial action selected shall attain a degree of cleanup that, at a minimum, assures protection of human health and the environment.

For this Final FS, the EPA and the NDEQ have determined that chemical specific ARARs are not available, but that the BHHRA and the EPA and state guidance are to be used for the evaluation and comparison of the remedial alternatives herein. Based on present knowledge, protection of human health can be assessed for remedial alternatives by considering the levels of protectiveness described in the BHHRA. Public health action-specific ARARs related to remedial actions are identified and considered once the alternatives have been developed in Section 6.

Table 2-1
Potential Federal Chemical-Specific ARARs

	Citations	Prerequisite	Requirement
A. Applicable Requirements	None		
B. Relevant and Appropriate	None		
1. Safe Drinking Water Act	National Primary Drinking Water Standards 40 C.F.R. Part 141 Subpart B and G	Establish maximum contaminant levels (MCLs), which are health based standards for public waters systems.	Required to meet MCLs.
2. Safe Drinking Water Act	National Secondary Drinking Water Standards 40 C.F.R. Part 143	Establish secondary maximum contaminant levels (SMCLs) which are non-enforceable guidelines for public water systems to protect the aesthetic quality of the water.	SMCLs may be relevant and appropriate if groundwater is used as a source of drinking water.
3. Safe Drinking Water Act	Maximum Contaminant Level Goals (MCLGs) 40 C.F.R. Part 141, Subpart F	Establishes non-enforceable drinking water quality goals.	The goals are set to levels that produce no known are anticipated adverse health effects. The MCLGs include an adequate margin of safety.
4. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life.	May be relevant and appropriate to surface water discharges, or may be a TBC.
5. Clean Air Act	National Primary and Secondary Ambient Air Quality Standards 40 C.F.R. Part 50	Establishes standards for ambient air quality to protect public health and welfare.	Requires air emissions to meet clean air standards.
6. National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122, 125	Determines maximum concentrations for the discharge of pollutants from any point source into waters of the Untied States.	Requires non point discharge to meet NPDES permit standards.
B. To Be Considered			
1. EPA Revised Interim Soil-lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, August 1994 OSWER Directive 9200.4-27P, August 1988	Establishes screening levels for lead in soil for residential land use, describes development of site-specific preliminary remediation goals, and describes a plan for soil-lead cleanup at CERCLA sites.	This guidance recommends using the EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) on a site-specific basis to assist in developing cleanup goals.
2. EPA Strategy for Reducing Lead Exposures	EPA, February 21, 1991	Presents a strategy to reduce lead exposure, particularly to young children.	The strategy was developed to reduce lead exposure to the greatest extent possible. Goals of the strategy are to 1) significantly reduce the incidence above 10 µg Pb/dL in children; and 2) reduce the amount of lead introduced into the environment.
3. Human Health Risk Assessment		Evaluates baseline health risk due to current site exposures and establish contaminant levels in environmental media at the site for the protection of public health because ARARs are not available for contaminants in soils.	The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contamination in soils.

Table 2-1, Continued
Potential Federal Chemical-Specific ARARs

	Citations	Prerequisite	Requirement
4. Superfund Lead-Contaminated Residential Sites Handbook	EPA OSWER 9285.7-30, August 2003.	Handbook developed by EPA to promote a nationally consistent decision making process for assessing and managing risks associated with lead contaminated residential sites across the country.	Use the available data to determine what has been done nationally to assess local risks.
5. Toxic Substances and Control Act (TSCA)	Lead-Based Paint Poisoning Prevention in Certain Residential Structures 40 CFR Part 745	Establishes EPA requirements for addressing lead-based paint poisoning prevention in certain residential structures.	Identifies and sets requirements for maximum amount of lead in dust samples collected from windows sills and floors. Impose requirements on the seller or lessor of target housing to disclose to the purchaser or lessee the presence of any known lead-based paint hazards, provide available records and reports, and attach specific disclosure and warning language to the sales or leasing contract.
6. Lead-Based Paint Poisoning Prevention Act; Residential Lead-Based Paint Hazard Reduction Act	Lead-Based Paint Poisoning Prevention in Certain Residential Structures 24 CFR Part 35	Establishes HUD requirements for addressing lead-based paint poisoning prevention in certain residential structures.	Identifies and sets requirements for maximum amount of lead in dust samples collected from windows sills, window troughs and floors. Establishes requirements for seller or lessor of target housing to disclose the presence of any known lead-based paint and/or lead-based paint hazards to purchaser or lessee and provide available records and reports. Sets requirements for amount of lead in paint.

Table 2-2
Potential State Chemical-Specific ARARs

	Citations	Prerequisite	Requirement
A. Applicable Requirements	None		
B. Relevant and Appropriate Requirements			
1. Nebraska Surface Water Quality Standards	Nebraska Department of Environmental Quality - Title 117	Regulates the discharge of constituents from any point source, including stormwater, to surface waters of the state. Provides for maintenance and protection of public health and aquatic life uses of surface water and groundwater.	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges.
2. Nebraska Safe Drinking Water Act	Nebraska Rev. Stat. 71-5301 et seq. and Title 179, Chapter 2	Establishes drinking water standards (MCLs), monitoring standards, and other treatment requirements.	Required to meet MCLs.
3. Nebraska Air Pollution Control Rules and Regulations	Nebraska Department of Environmental Quality - Title 129	Establishes Ambient Air Quality Standard and regulates emissions of contaminants into the air.	Required to meet ambient air quality standards.
C. To Be Considered			
1. Human Health Risk Assessment Report (HHRA)		Evaluates baseline health risk due to current site exposures and established contaminant levels in environmental media at the site for the protection of public health.	The risk assessment approach using this data should be used in determining cleanup levels because ARARs are not available for contaminants in soils.
2. Nebraska Voluntary Cleanup Program (VCP) Guidance	Nebraska Voluntary Cleanup Program Guidance, NDEQ, October 2008	Establishes cleanup levels or remediation goals for sites that are remediated under the Nebraska Voluntary Cleanup Program.	Table in Attachment 2-6 contains VCP Remediation Goal for lead in residential soil of 400 mg/kg based on direct contact exposure pathway.

Table 2-3
Potential Federal Location-Specific ARARs

	Citations	Prerequisite	Requirement
A. Applicable Requirements			
1. Historic project owned or controlled by a federal agency	National Historic Preservation Act: 16 U.S.C. 470, et.seq; 40 C.F.R. § 6.301; 36 C.F.R. Part 1.	Property within areas of the Site is included in or eligible for the National Register of Historic Places.	The remedial alternatives will be designed to minimize the effect on historic landmarks.
2. Site within an area where action may cause irreparable harm, loss, or destruction of artifacts.	Archeological and Historic Preservation Act; 16 U.S.C. 469, 40 C.F.R. 6.301.	Property within areas of the site contains historical and archaeological data.	The remedial alternative will be designed to minimize the effect on historical and archeological data.
3. Site located in area of critical habitat upon which endangered or threatened species depend.	Endangered Species Act of 1973, 16 U.S.C. 1531-1543; 50 C.F.R. Parts 17; 40 C.F.R. 6.302. Federal Migratory Bird Act; 16 U.S.C. 703-712.	Determination of the presence of endangered or threatened species.	The remedial alternatives will be designed to conserve endangered or threatened species and their habitat, including consultation with the Department of Interior if such areas are affected.
4. Site located within a floodplain soil.	Protection of Floodplains, Executive Order 11988; 40 C.F.R. Part 6.302, Appendix A.	Remedial action will take place within a 100-year floodplain.	The remedial action will be designed to avoid adversely impacting the floodplain in and around the soil repository to ensure that the action planning and budget reflects consideration of the flood hazards and floodplain management.
5. Wetlands located in and around the soil repository.	Protection of Wetlands; Executive Order 11990; 40 C.F.R. Part 6, Appendix A.	Remedial actions may affect wetlands.	The remedial action will be designed to avoid adversely impacting wetlands wherever possible including minimizing wetlands destruction and preserving wetland values.
6. Structures in waterways in and around the soil repository.	Rivers & Harbors Act, 33 C.F.R. Parts 320-330.	Placement of structures in waterways is restricted to pre-approval of the U.S. Army Corps of Engineers.	The remedial action will comply with these requirements.

Table 2-3 (Continued)
Potential Federal Location-Specific ARARs

	Citations	Prerequisite	Requirement
7. Water in and around the soil repository.	Clean Water Act, (Section 404 Permits) Dredge or Fill Substantive Requirements, 33 U.S.C. Parts 1251-1376; 40 C.F.R. Parts 230,231.	Capping, dike stabilization construction of berms and levees, and disposal of contaminated soil, waste material or dredged material are examples of activities that may involve a discharge of dredge or fill material. Four conditions must be satisfied before dredge and fill is an allowable alternative.	1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State water quality standards, violate applicable toxic effluent standards, jeopardize threatened or endangered species or injure a marine sanctuary. 3. No discharge shall be permitted that will cause or contribute to significant degradation of the water. 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.
8. Area containing fish and wildlife habitat in and around the soil repository.	Fish and Wildlife Conservation Act of 1980, 16 U.S.C. Part 2901 et seq.; 50 C.F.R. Part 83 and 16 U.S.C. Part 661, et seq. Federal Migratory Bird Act, 16 U.S.C. Part 703.	Activity affecting wildlife and non-game fish.	Remedial action will conserve and promote conservation of non-game fish and wildlife and their habitats.
B. Relevant and Appropriate Requirements			
1. 100-year floodplain	Location Standard for Hazardous Waste Facilities- RCRA; 42 U.S.C. 6901; 40 C.F.R. 264.18(b).	RCRA hazardous waste treatment and disposal.	Facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout during any 100-year/24 hour flood.
C. To Be Considered	None		

Table 2-4
Potential State Location-Specific ARARs

	Citations	Prerequisite	Requirement
A. Applicable Requirements			
1. Solid waste management regulations	Nebraska Department of Environmental Quality – Title 132 – Integrated Solid Waste Management Regulations	Requires permits for proper identifications and disposal of solid waste in municipal solid waste disposal areas.	Requires specified procedures for the location, design, operation, and ground water monitoring, closure, disposal, post closure, and financial assurance for solid waste disposal facilities. Requires specific procedures for special waste management.
2. Siting Procedures and Policies	Nebraska State Statutes 13-1701 to 13-1714	Policies and procedures are required in order to get approval for a solid waste disposal.	Requires approvals by local jurisdictions prior to the development of a site as a solid waste disposal area.
3. Flood-plain Management Act	Nebraska State Statues 13-1001 to 31-1031 and Title 258	Policies and procedures for construction or disposal in flood plains.	Governs certain activities occurring in flood plains
4. Nebraska Nongame and Endangered Species Act	Nebraska State Statues 37-801 to 37-811 and Title 163 Chapter 4, 012	Policies and procedures to ensure protection of Threatened and Endangered species Requires consultation with Nebraska Game and Parks Commission.	Requires actions which may affect threatened or endangered species and their critical habitat.
B. Relevant and Appropriate Requirements	None		
C. To Be Considered.			
1. Hazardous waste handling, transport and disposal regulations	Nebraska Department of Environmental Quality – TITLE 128 Nebraska Hazardous Waste Regulations	Requires operating permits for proper identifications, handling, transport, and disposal of hazardous materials.	Supplement the federal RCRA regulations and define state permitting requirements.
2. Siting Procedures and Policies	Nebraska State Statutes 81-1521.08 to 81-1521.23	Policies and procedures are required in order to get approval for a hazardous waste management facility.	Requires approvals by local jurisdictions prior to the development of a site as a hazardous waste management facility.

3.0 Remedial Action Objectives and Action Levels

In Section 1.0, the problem of residential soil contamination from lead refining/processing in Omaha was discussed. The purpose of this section is to develop goals for the remedial action and to present remedial technologies that can be applied to residential soils to meet the goals. Section 4.0 discusses the remedial alternatives that have been assembled using these technologies.

3.1 Remedial Action Objectives

This section defines the goals of the remedial action, and identifies the remedial action objectives (RAOs) for residential soils at the OLS. RAOs consist of quantitative goals for reducing human health and environmental risks and/or meeting established regulatory requirements at Superfund sites. Site characterization data, BHHRA results, ARARs, and other relevant site information are used to develop RAOs.

Based on current site data and evaluations of potential risk, lead was identified as being a contaminant of concern and the primary cause of human health risk at the site is through direct ingestion.

One RAO has been developed for residential soils in Omaha:

- Reduce the risk of exposure of young children to lead such that an individual child, or group of similarly exposed children, have no greater than a 5 percent chance of having a blood-lead concentration exceeding 10 micrograms per deciliter (ug/dL).

3.2 Development of Preliminary Remediation Goals and Action Level

3.2.1 Preliminary Remediation Goals for Protection of Children

The Syracuse Research Corporation prepared an October 16, 2008 memorandum that developed preliminary remediation goals (PRGs) for protection of children from lead in surface soils at the OLS. This memorandum is presented in Appendix C of this Final FS report. The PRG for lead in soil is based on the average mid-yard concentration of lead in a residential property that is associated with no more than a 5 percent chance that a child (age 0-84 months of age) living at the property will have a blood lead level that exceeds 10 µg/dL. The probability of having a blood lead level above 10 µg/dL is referred to as P10. The RAO for the final remedy at the OLS corresponds to this goal of less than a 5 percent probability for a child or group of similarly exposed children to have blood lead levels exceeding 10 µg/dL following completion of the remedial action.

The IEUBK model was used to determine the concentration of lead in soil that yields a P10 value which meets EPA's RAO for the OLS (P10 < 5 percent). PRGs were determined based on analysis of the fine-grained soil (< 250 μm) using a laboratory analytical method such as Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) as well as analysis of the bulk soil fraction (< 2 mm) using an X-Ray fluorescence (XRF) instrument. Each soil fraction in combination with a particular analytical method will yield a different PRG, as explained further in the OLS BHHRA (Ref. 30).

The PRG values which are derived from the IEUBK model are somewhat uncertain, due to uncertainty in the true values of the model and input parameters used in the IEUBK model calculation. Two important sources of uncertainty in the development of the PRG values involve uncertainty regarding the true relative bioavailability of soil lead and the relationship between lead in indoor dust and outdoor soil. Both of these factors serve as inputs to the IEUBK model. For the purpose of the PRG evaluation, a series of alternate PRG calculations was performed to evaluate the uncertainty that arises from variation in the relative bioavailability and the relationship between lead in interior dust and outdoor soil. These two factors were varied within a range of possible values, based on the varying results of site-specific investigations previously performed, in order to determine a plausible range of PRGs that would correspond to a P10 of less than 5 percent.

This plausible range of PRGs was calculated separately for analysis of the bulk fraction versus fine fraction of soil, and separately assuming the use of XRF versus ICP-AES analysis. Because the routine decision-making protocol guiding response action at individual properties at the OLS involves analysis of bulk soil samples using an XRF instrument, the PRG range calculated using this combination is of primary interest. Using XRF analysis of bulk soil, the plausible PRGs meeting the RAO for soil at the OLS range from 208 ppm to 366 ppm with a best estimate of 247 ppm. These PRGs are based on average mid-yard lead concentrations.

Since the maximum lead concentration in a single quadrant (not the average mid-yard concentration) is compared to an action level to determine if soil remediation will be conducted at a property, an additional calculation must be performed to determine the average mid-yard concentration that will result at each property following soil remediation. Under the current remedial action at the OLS[1], soil remediation involves removal of soil exceeding 400 ppm from all quadrants and the drip zone at individual properties. Since soils exceeding 400 ppm are removed during remediation, the average mid-yard concentration is greatly reduced at remediated properties. For the purpose of determining the resulting average mid-yard soil lead concentration, it can be assumed that some amount of background soil lead is present in the backfill soil that is used to replace excavated soils exceeding 400 ppm. For this calculation, the background concentration in

[1] Remedial action under the current Interim Record of Decision is initiated at properties that are determined to be eligible if one or more mid-yard soil lead concentration exceeds the appropriate action level -- 800 ppm for typical properties and 400 ppm for EBL, child-care, and high-child impact properties.

clean soils used for backfill is assumed to be 20 ppm lead. To calculate the average mid-yard concentrations at remediated properties, it is assumed that all quadrants exceeding 400 ppm are excavated and replaced with soil having a lead concentration of 20 ppm.

The average mid-yard lead concentration that would remain following removal of soil in quadrants exceeding 400 ppm was calculated for the 33,331 individual properties that were sampled at the OLS through October 2008. The calculated average mid-yard lead concentration following remediation is then compared to the plausible range of PRGs that have been determined to meet the RAO. Of the 33,331 individual properties sampled at the OLS through October 2008, soil lead levels exceed 400 ppm in at least one mid-yard quadrant at 12,361 properties. Removal of quadrants exceeding 400 ppm at these properties would effectively reduce average mid-yard concentrations to much less than 366 ppm, which is the upper end of the range of plausible PRG values, since the presence of at least one quadrant that has been reduced to 20 ppm would significantly reduce the yard-wide average soil lead concentration. Of the remaining properties which are not eligible for soil remediation (i.e. individual mid-yard concentrations are all less than 400 ppm) average mid-yard lead concentrations are already less than 366 ppm at all but 21 properties. These 21 properties represent less than 0.07 percent of the 33,331 properties sampled at the OLS through October 2008. Based on these occurrences, it can be estimated that 4 additional properties of the 5,210 properties yet to be sampled at the OLS would have average mid-yard lead concentrations exceeding 366 ppm following remediation of eligible properties. This would increase the total number of properties with average mid-yard lead concentrations that do not fall within the plausible PRG range to only 25. Therefore, removing soils that exceed a 400 ppm action level based on individual quadrant mid-yard lead concentrations would reduce soil lead levels at virtually all OLS properties to meet the soil lead RAO.

In almost all cases, selection of a 400 ppm action level, as applied at the OLS, would reduce the residual risk following soil remediation to meet the RAO. During the remedy selection process, EPA may consider other measures to further reduce residual risk at the OLS. For example, EPA may consider additional response at the 25 individual properties that would remain with mid-yard concentrations that slightly exceed the plausible PRG range. In addition, EPA may include various types of institutional controls or other types of non-engineering measures to further control risks associated with lead exposure at all OLS properties. For the purpose of this Final FS, it is assumed that the RAO for soil lead would be met by removing or otherwise preventing exposure to soils exceeding 400 ppm based on measurements of individual quadrants. A 400 ppm soil lead action level for the OLS will be carried forward in this Final FS for development and comparison of remedial alternatives. EPA will select a final action level in the Final ROD following public review and comment on the preferred alternative presented in the Proposed Plan.

3.2.2 Preliminary Remediation Goals for Protection of Excavation Workers

Syracuse Research Corporation also prepared a March 16, 2009 memorandum that developed PRGs for protection of excavation workers from lead in subsurface soils at the OLS. This memorandum is presented in Appendix D of this Final FS report. The value of the PRG depends on the assumed frequency of exposure at the OLS, ranging from 1 day per week up to 5 days per week. The resulting PRG values represent the maximum acceptable average concentration of lead in subsurface soil that a worker may be exposed to in the OLS during a 13-week (91 day) work period. Based on available data on lead concentration values in soil as a function of depth, subsurface lead concentrations tend to be lower than surface concentrations, and all of the average values for lead in soil at various depths are substantially lower than all of the PRGs for an excavation worker, even if exposure is assumed to be very frequent (5 days/week). Based on this, it was concluded that risks to excavation workers in the OLS from exposure to lead in soil are not of significant health concern.

3.2.3 Number of Properties Requiring Remediation

The total number of residential properties that will require soil remediation under this Final FS is estimated at 9,966 properties. This number was determined from the previously sampled properties with lead soil concentrations greater than 400 ppm (12,696 properties) less the 4,611 properties containing lead concentrations properties greater than 400 ppm that have already been remediated. There are a total of 8,085 previously sampled properties with a lead concentration above 400 ppm that need to be remediated. Of the remaining 5,210 properties that have not been sampled, it is estimated that 1,881 will need to be remediated. This assumption is based on the percentage of previously sampled properties that have lead concentrations greater than 400 ppm.

4.0 Identification and Screening of Applicable Technologies and Process Options

General response actions have been identified to satisfy the RAO established for the site. The general response actions include no-action, institutional controls, excavation, disposal, capping, and chemical treatment. Remedial technologies and process options have been selected and screened for the general response actions. Remedial technologies include excavation and removal, capping, and chemical treatment. Process options for excavation and removal involve partial or complete excavation of a property. Capping would involve placing a protective barrier over the contaminated soil using soil, geosynthetics, or vegetation. Chemical treatment would involve immobilizing the lead by applying a stabilization agent to the soil. The screening evaluation was based on technical and administrative implementability, effectiveness, and relative cost. The screening process for the remedial technologies and process options is discussed in this section.

4.1 Institutional Controls

Institutional controls (IC) are non-engineered instruments, such as administrative and/or legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of a remedy. ICs work by limiting land or resource use and by providing information that helps modify or guide human behavior at a site. ICs are developed to reduce or prevent exposure to contamination in soil and dust and to protect the remedy where wastes are left in place. Therefore, ICs are included in this section along with engineered technologies. The following categories of IC mechanisms are discussed in this Final FS: Proprietary Controls, Government Controls, Enforcement and Permit Tools with IC Component, and Informational Devices.

4.1.1 Proprietary Controls

Proprietary controls are based on State law and use a variety of tools to prohibit activities that may compromise the effectiveness of the remedy or restrict activities or future uses of resources that may result in unacceptable risk to human health or the environment. They may also be used to provide site access for operation and maintenance activities. The most common examples of proprietary controls are easements and restrictive covenants that control certain uses of the property. This type of IC "runs with the land" and is binding on subsequent purchasers of the property. This type of IC is not presently being used to control activities at the OLS.

4.1.2 Government Controls

Government controls impose land or resource restrictions using the authority of an existing unit of government. Typical examples of government controls include zoning, building codes, and other ordinances. Zoning is an exercise of police power, which is defined as the authority of the government to exercise controls to protect the public's health, safety and welfare. Zoning ordinances typically consist of a map indicating the various land use zones in the community and set forth the regulations for the development of land. Zoning can serve as an effective IC when a large number of properties are affected by the remedy.

Local governments may also adopt building codes or other ordinances to protect the public. They may require property owners seeking a building permit for construction activities in a particular area to be notified of contamination and informed of any relevant management requirements for the contamination. Such measures could be used to prohibit certain types of construction (such as excavation) that would result in unacceptable exposures.

Other types of local ordinances could address requirements for property owners that rent properties to ensure that their properties do not pose an unacceptable health risk to their tenants. Local ordinances could also require lead hazards at properties to be mitigated or abated.

4.1.3 Enforcement and Permit Tools with IC Components

Enforcement and permit tools with IC components include orders, permits, and consent decrees. These instruments may be issued unilaterally or negotiated to compel a party to limit certain site activities as well as ensure the performance of affirmative obligations. Enforcement orders could potentially be used to enable EPA to obtain access to properties to sample the soil.

4.1.4 Informational Devices

Informational devices provide information or notification about whether a remedy is operating as designed or that residual or contained contamination may remain on site. Typical information devices include state and local registries, deed notices, advisories, and public health education activities.

Deed notices are filed in the local land records but, unlike proprietary controls, are not intended to convey an interest in real property. Consequently, such notices do not serve as enforceable restrictions on the future use of the property. However, a deed notice does provide notice to anyone reviewing the chain of title that the property either is, or was, contaminated and whether there may be other restrictions on the property.

The state or local governments could establish and maintain a registry that contains information concerning the properties at the site such as the status of soil sampling, soil remediation, LBP assessments, LBP stabilizations, or LBP certifications indicating that the property does not present a hazard.

4.2 Public Health Education

Public health education involves distribution of information about metal exposure to people in areas affected by metals in soils. Education can alert residents to the issues of exposure routes, sources of metals, people at risk, and preventative measures. Educating citizens living in residences with metals in soils can be used as a supplemental action to reduce exposure and decrease risk. Specific education activities that may prove effective at reducing exposures include:

- Providing community education through meetings and literature.
- Distributing fact sheets containing information on controlling lead exposure.
- Establishing public information centers that may distribute written information on controlling lead hazards or respond to questions from the public concerning lead hazards.
- Providing lead hazard information to the public through public media (television, radio, newspapers, internet).

Education, especially if it is the primary means of reaching remediation goals, must be an ongoing process. A limitation to public education is that educational programs require not only the cooperation of public health institutions, but public cooperation as well, to be successful. In addition, public concern and awareness may wane with time unless a continual mechanism of public education is in place. Additionally, education activities conducted over a long period of time can become expensive. Typically, the EPA prefers that health education is not a stand-alone remedy, but is used only as a supplemental activity in conjunction with an engineered action. Health education activities are useful to help address initial site risks as the remedy is implemented, and then could be phased out as cleanup of the contamination is completed.

4.3 Excavation

Excavation prevents human contact with soils through physical removal of soils for disposal. Residential soils can be either partially or totally removed. Soil excavation may be difficult and costly, particularly if properties are confined, inaccessible, steeply sloped, or contain trees, shrubs, walkways, and driveways.

4.3.1 Partial Removal

Partial removal of soils refers to excavation of portions of properties containing concentrations of lead above the action level and leaving behind soils with concentrations of lead below the action level. Portions of a property, but not the entire property, may contain soil with lead above the action level. Partial removal of soils may be appropriate for these properties. The limitation of partial excavation is the need for extensive testing to carefully delineate the soils to be removed. However, the cost for testing may be offset by the lower removal, transportation, and disposal costs for smaller quantities of soil. All excavated soils require appropriate disposal.

4.3.2 Complete Removal

Complete removal is the excavation of soil to a predetermined depth for entire residential properties. Complete excavation may not be appropriate because soils containing low concentrations of lead with little associated risk are removed, along with soils containing higher lead concentrations. In addition, complete removal may result in more unavoidable disturbance/disruption to property such as destruction of flower beds, gardens, and other sensitive areas of the home that could be avoided if soil testing indicates some areas of the property contain lead concentrations that are below a level of concern. Complete soil removal may be most appropriate where the majority of the properties contain soil contamination above the action level, and the extensive sampling associated with partial removal may be eliminated. The EPA has information for this site indicating that many of the residential properties with soil concentrations above the action level also have areas of their properties below the action level, and a complete removal of soils from properties may not be necessary. This technology is not considered further because of the much higher costs associated with complete removal.

4.4 Disposal

Disposal options must be considered with either partial or total excavation. The metals-contaminated soils removed from residential areas will require disposal in a secure facility. Several options exist for disposal of lead-contaminated soil from the Omaha site and are discussed in the following paragraphs.

4.4.1 New Repository

A soil repository could be constructed on an existing area within or near the Superfund site. The repository, which would be covered and/or revegetated, would allow for disposal of soils in a controlled environment, minimizing transport of lead. The primary limitation for this technology is land availability. Additionally, if the EPA constructed a discrete on-site repository for lead-contaminated soil disposal, the facility may require long-term operation and maintenance (O&M) by the State of Nebraska or through a permanent and enforceable agreement with the property owner.

4.4.2 Sanitary Landfill

Soils could also be disposed in off-site sanitary landfills as daily cover or as a special waste. The advantage of using existing landfills is the elimination of design and construction of a soil repository. The limitations of using an off-site disposal facility are possible regulatory constraints and cost. Costs for off-site disposal could be greater than on-site disposal due to the additional transportation expense and tipping fees at the landfill. Use as daily cover could reduce cost by lowering or eliminating tipping fees and reducing the tax burden. Another disadvantage to disposal in a sanitary landfill may be a limitation in the capacity of the landfill used for the soil disposal. Additionally, the soils require testing, prior to disposal, using the toxicity characteristic leaching procedure (TCLP). If soils fail the TCLP test for lead, pretreatment would be required prior to disposal. Because of the potentially large quantities of soil to be generated from excavation activities, pretreatment of soil prior to disposal may be difficult to implement, as well as cost prohibitive.

4.4.3 Commercial Backfill

The soil excavated from the residential properties in Omaha potentially could be used as beneficial fill in a commercial land use project, if it can be demonstrated that there would be no unacceptable risk to human health or the environment. While the lead-contaminated soil presents a hazard to humans, especially children, in residential settings, no significant risks would be created in a commercial or industrial setting if the soil is properly placed and appropriate ICs are placed on the disposal property.

4.5 Capping Technologies

Capping prevents direct human contact with waste. The technologies used for capping include:

- Soil
- Geosynthetics
- Vegetation

Capping technologies could be used separately or in combination, in individual properties or in a central soil repository, or in other land use projects, to prevent human contact with metals in soil. Each of the capping technologies is described in the following subsections.

4.5.1 Soil Capping

Soil caps are constructed using either simple topsoil covers or low permeability clay layers to prevent human contact and transport of soils off site. Simple topsoil caps could be used directly in residential properties to cover contaminated soil with a protective layer, preventing human contact with the covered contaminated soil. The advantage of topsoil capping is that contaminated soils remain in place, eliminating excavation, transport, and disposal problems. However, in-place capping would raise the property level 6 to 12 inches, which creates problems in correct contouring to existing driveways, walkways, and below grade window openings of homes. In large properties, capping could be used effectively in combination with excavation to achieve proper final grading of the property around existing structures.

Low permeable clay caps, although not applicable for residential properties, may be used as final cover for soil disposal areas. These types of soil covers are typically used for preventing infiltration of water into a contaminated soil disposal pile and to control future contaminant migration from the soil disposal area.

4.5.2 Geosynthetics

Geosynthetics can consist of geotextile fabrics and geomembrane barriers. Geotextile fabrics are woven from synthetic material and made to withstand both chemical degradation and biodegradation. The fabric is laid over untreated or undisturbed soils, effectively separating them from clean fill material. In residential soils, geotextiles can be used as either a physical or visual barrier to separate the clean soil cover from underlying contaminated soil. The advantage of these barriers is that a resident digging in a remediated property with contamination at depth would be notified of the contamination by the presence of the barrier.

Geomembrane barriers also have applicability as cover material over a soil disposal area to prevent surface water infiltration and control surface migration of contaminants. These types of covers, however, are much more costly than soil covers.

4.5.3 Vegetation

Vegetative covers such as sod can prevent human contact with soils by creating a physical barrier. Roots from cover plants hold the soil in place, preventing erosion and off-site transport by surface runoff or wind. Vegetative covers may be appropriate alone for soils with low concentrations of metals. Vegetative covers may also be used in conjunction with clay caps, clean fill (dust control), or geotextile fabrics. The advantage of a vegetative cover is that grass grows well in the Omaha area and, with proper maintenance, can be an effective barrier. The limitation of a vegetative cover is that routine maintenance (i.e., mowing, watering, and fertilizing) is necessary to maintain the cover. An additional disadvantage of a grass-only cover is that the protective layer is very thin, and without proper maintenance, the grass can die and contaminated soil can be readily re-exposed.

4.6 Stabilization

Stabilization refers to treatment of soils with chemical agents to either fix metals in place or form complexes that make metals less toxic. Two methods of stabilization appropriate for lead contamination are pozzolanic stabilization and phosphate addition. These technologies are both routinely used as treatment technologies in certain applications. Each stabilization method is described in the following subsections.

4.6.1 Pozzolanic Stabilization

Pozzolanic stabilization of residential soils is the addition of a solidifying agent such as Portland cement or fly ash with soils to form a monolith, similar to concrete. The pozzolan is added in place by introduction of a slurry mixture into the soil with auger mixing. The monolith created would reduce leachability and mobility of metals in soils by reducing soil particle surface area and inhibiting human contact by encapsulating soils. The advantage of pozzolanic stabilization is that treatment materials are inexpensive and readily available. The limitations with in-place pozzolanic stabilization include increased material volume, which would change the elevation of properties. Since paving properties is not generally acceptable to residents, this technology will not be further evaluated for application in residential properties.

4.6.2 Phosphate Stabilization

Phosphate stabilization is a chemical stabilization procedure in which phosphate salts are added to soils in either solid or liquid form and mixed with the soil. Phosphate ions combine with lead to form the less soluble lead phosphate complexes. Although the metals are not removed from the property, they become less bioavailable to humans since the lead that occurs in the soil as lead-phosphate is less likely to be absorbed by the body when ingested.

Phosphate can be added to the soil in the form of phosphoric acid, triple-super phosphate, or phosphate rock. For purposes of developing an alternative for this Final FS, phosphate stabilization would consist of adding phosphorus in the form of phosphoric acid along with potassium chloride

(KCl) to the residential soils. This combination is intended to react with lead in the soil to form the extremely insoluble chloropyromorphite, thus rendering the lead unavailable for leaching and less bioavailable to humans. Following application of the phosphoric acid, lime would be added to raise the soil pH to acceptable levels and the property would be sodded. An advantage of phosphate stabilization is that a limited amount of soil would have to be removed. Limitations of phosphate stabilization include: (1) The bench scale treatability study performed using soils from the OLS suggested only a 20% reduction in bioavailability of lead could be achieved (Ref. 22); (2) pilot scale studies performed at other sites have demonstrated that in the short-term, phosphate stabilization may reduce the bioavailability of lead by 30 to 50 percent (Ref. 23 and Ref. 24), thus limiting its applicability to properties with high lead concentrations; (3) its long-term effectiveness is inconclusive; (4) the application of phosphoric acid to residential soils to reduce the bioavailability of lead has not been implemented on a large scale at residential properties which could raise public concerns; and (5) a large amount of phosphoric acid would be transported and used in residential areas, which could result in increased short-term risks during implementation.

4.7 Actions to Address Other Non-Soil Sources of Lead

The EPA is aware that lead in the environment at the OLS originates from many sources. In addition to the identified soil exposure pathway, which the above listed technologies will address, other important sources of lead exposure are interior and exterior LBP, lead-contaminated interior dust that originates from LBP and contaminated soil, and to a much lesser extent, tap water. Generally, sources other than soil, exterior paint, interior dust, and tap water cannot be remediated by the EPA in the course of residential lead cleanups. CERCLA and the NCP limit Superfund authority to address interior lead-based paint. For example, CERCLA Section 104(a) (3) (B) limits the EPA's liability to respond to releases within residential structures as follows:

> "Limitations on Response. The President (EPA) shall not provide for removal or remedial action under this section in response to a release or threat of release…from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures…"

The above cited section of CERCLA generally limits the EPA's authority to respond to lead-based paint inside a structure or house. In addition, hazardous substance, as used in the definition of a "facility", does not include consumer products such as paint that are in consumer use. However, the EPA has authority to address deteriorated LBP to prevent recontamination of soils that have been remediated.

The Office of Solid Waste and Emergency Response (OSWER) policy recommends against using money from the Superfund Trust Fund to address interior lead-based paint exposures, and recommends that actions to address or abate interior lead-based paint risks be addressed by others such as U.S. Department of Housing and Urban Development (HUD), local governments, health authorities, Potentially Responsible Parties (PRPs), private organizations, or individual homeowners. OSWER policy also recommends against using Superfund trust money to remove interior dust solely from lead-based paint or to replace lead plumbing within residential dwellings, and recommends that the regions seek partners to address these other lead exposure risks.

The EPA acknowledges the importance of addressing these other exposures in realizing an overall solution to the lead problems at residential Superfund sites. The EPA is committed to partnering with other organizations such as The Agency for Toxic Substances and Disease Registry (ATSDR), HUD, state environmental departments, state and local health departments and government agencies, private organizations, PRPs, and individual residents and to participate in a comprehensive lead risk reduction strategy that addresses lead risks comprehensively. The EPA can provide assessments of these other lead hazards to homeowners as part of its investigative activities and can provide funds to support health education efforts to reduce the risk of lead exposure in general. It should be noted that OSWER policy directs that the EPA should not increase the risk-based soil cleanup levels as a result of the action taken to address these other sources of exposure.

While acknowledging the importance of addressing lead exposures from all sources and developing a comprehensive approach, the EPA can only recommend, as part of a preferred or selected remedy, those actions that the EPA has the authority and policy direction to address. The EPA will make a determination regarding the need to remediate residential soils. At properties where a soil cleanup action is conducted, the EPA can also perform an assessment and provide recommendations to address other sources of lead exposures. In the absence of resources from other parties to address such lead hazards, at residences where remediation of soils is performed, the EPA remedy could also address:

- Controlling interior lead-contaminated dust through professional cleaning or providing high efficiency particulate air vacuum cleaners (HEPAVAC) to home owners when exterior soil contributes to interior dust contamination.
- Assessing the condition of, and stabilizing or otherwise controlling hazards at properties where flaking lead-based paint may threaten the future protectiveness of a soil cleanup by re-contaminating the clean soil placed in the excavated areas.
- Providing support to a health education program during cleanup actions.

4.8 Screening of Identified Technologies

This section screens the remedial technologies identified in Sections 4.1 through 4.6 for further consideration in developing remedial alternatives to satisfy the RAO.

4.8.1 No-Action

The "no-action" general response action is required as a baseline alternative against which the effectiveness of the other alternatives can be compared. Under this alternative, no remedial actions are taken at the site. Current risks posed from contaminants at the site remain unmitigated, uncontrolled, and unmanaged. Actions taken to reduce the potential for exposure (e.g. site fencing, deed restrictions, etc.) are not to be included as a component of the no-action alternative.

4.8.2 Institutional Controls

<u>Proprietary Controls</u>

Proprietary controls include easements and restrictive covenants that convey interests in real property. This type of IC "runs with the land" and is binding on subsequent purchasers of the property. Proprietary controls are difficult to implement because it is necessary for the restrictions to extend beyond the period of the remedial action and the EPA does not have a property interest at the site. This type of IC is not presently being used to control activities at the OLS and will not be carried forward for incorporation into a remedial alternative.

<u>Governmental Controls</u>

Government controls that impose land restrictions using the authority of an existing unit of government are applicable to the OLS. Typical examples of government controls include zoning, building codes, and other ordinances. Although zoning can serve as an effective IC when a large number of properties are affected by the remedy, a zoning ordinance that would restrict use of existing residential properties at the OLS may not be readily implementable and will not be carried forward for incorporation into a remedial alternative.

Local building codes or other ordinances to protect the public are a practical method to control lead hazards. The City of Omaha is presently considering an ordinance that makes it unlawful for any property owner to rent or allow the residential use by another person of a residential premise constructed prior to January 1, 1978, unless the property owner has provided the tenant a written certification by a state-certified lead paint risk assessor that (1) indicates the premises have been tested for lead paint and were found to not contain lead paint on any interior or exterior surface or (2) any lead dust found on the premises meets the standards of HUD regarding the presence of lead dust on window sills, window troughs, and floors, and that none of the lead paint on or within the premises is flaking, cracking, peeling, scaling, blistered, chipped, or loose.

A second ordinance under consideration by the City of Omaha would make it a nuisance to maintain or allow any open or exposed surface in any dwelling which is coated with, or consists of, or contains any lead-bearing substance if the surface is accessible or may become accessible to ingestion or inhalation by any person.

Enforcement and Permit Tools with IC Components

Enforcement and permit tools with IC components include orders, permits, and consent decrees. Enforcement orders could potentially be used to enable EPA to obtain access to properties to sample or remediate the soil. Although EPA may eventually use enforcement orders to obtain access to sample properties, enforcement orders will not be carried forward for incorporation into a remedial alternative.

Informational Devices

Informational devices provide information about the OLS to property owners. Informational devices will be carried forward for incorporation into the remedial alternatives. An information device that will be carried through for incorporation into the alternatives is establishment of a local registry that contains information concerning soil sampling, soil remediation, LBP assessments, LBP stabilizations, and LBP certifications indicating that the property does not present a hazard.

4.8.3 Public Health Education

Public health education includes providing community education through meetings and literature, distributing fact sheets containing information on controlling lead exposure; establishing public information centers that may distribute written information on controlling lead hazards or respond to questions from the public concerning lead hazards; and providing lead hazard information to the public through public media (television, radio, newspapers, internet). Public health education is an effective means of controlling exposure to lead and will be carried forward for incorporation into the remedial alternatives.

4.8.4 Excavation

Excavation of contaminated soil from residential properties is an accepted and highly utilized technology for addressing site risks. Excavation is easily implementable with readily available equipment. For purposes of this report the excavation process option includes backfilling excavated properties with clean soil. This technology will be carried forward for consideration in developing remedial alternatives to address the site risks.

4.8.5 Disposal

Disposal of contaminated soil excavated from residential properties is an accepted and highly utilized technology for addressing site risks. Disposal is easily implementable with readily available equipment. Several options have been identified for disposal of the excavated contaminated soil. For purposes of this report, the excavation process option includes transportation of the excavated soil to a sanitary landfill for use as landfill cover. The sanitary landfill where the excavated soil is presently used for daily cover is the Loess Hills Regional Landfill located in Malvern, Iowa. This technology will be carried forward for consideration in developing remedial alternatives to address the site risks.

4.8.6 Capping Technologies

Capping of large residential properties with clean topsoil to reduce exposures to contamination is less costly than excavation and disposal, yet still may be as protective in preventing exposure. Other types of capping, such as paving, are not practical for residential property soil contamination. Capping with topsoil will be retained for consideration in developing remedial alternatives to address the site risks.

Geomembrane barriers and low permeable clay caps have applicability for cover material over the soil disposal area to prevent surface water infiltration and control surface migration of contaminants. Geotextile fabrics can also be used as a physical barrier in residential properties to separate clean fill from contaminated soil at the bottom of excavations. These types of technologies will be retained for consideration during remedial alternative development, to address the soil disposal areas, and in some instances, in residential properties.

Vegetative covers are not considered protective when used alone in residential properties and will not be retained for consideration in developing remedial alternatives for residential properties. Vegetative covers are applicable for use in capping excavated soil at disposal areas and are retained for further consideration in those applications.

4.8.7 Stabilization

Pozzolonic stabilization is not an appropriate technology for residential soil in that it essentially turns the soil into a concrete slab. This technology will not be considered further.

The Omaha Lead Site Draft Treatability Study (Ref. 22) indicates minimal reduction (20%) in lead bioavailability using phosphate-based soil amendments as a stabilizing agent. Previous pilot scale studies have demonstrated that phosphate stabilization may reduce the bioavailability of lead by 30 to 50 percent in some soils (Ref. 23 and Ref. 24). However, the long-term effectiveness of phosphate stabilization to reduce the bioavailability of lead in soils has not been demonstrated. However, this technology will be retained for further consideration in a remedial alternative.

5.0 Development of Alternatives

This section documents the development of remedial alternatives for residential soils. Appropriate soil treatment and disposal technologies have been combined into three alternatives to address human exposure to residential soils at the OLS. To avoid considering all possible combinations of technologies, criteria are applied to limit the number of alternatives to only the most effective and implementable. The criteria for combining technologies into alternatives are:

- Alternatives must address the RAO.
- Alternatives must consist of unified groups of technologies.
- Alternatives must represent the full range of possible remedies from No Action to treatment and/or removal. Two alternatives that incorporate treatment and/or removal, along with the No Action alternative are developed in this section to address residential properties.

As the alternatives have been developed they were screened, as appropriate, based on cost, implementability, and effectiveness in accordance with the NCP requirements.

The following general technologies identified in Section 3 have been retained for consideration in developing the remedial alternatives. Other technologies were eliminated as either not technically practical or not cost effective for the OLS.

- Government Controls
- Informational Devices
- Public Health Education
- Excavation
- Disposal
- Capping
- Phosphate Stabilization

5.1 Preliminary Remedial Alternatives

The following alternatives are based on the applicable technologies identified in Section 4 and were developed to most efficiently meet the RAO and satisfy the ARARs. Also included for comparison is the No Action alternative. Additionally, the alternatives were developed to specifically address contamination resulting from industrial operations.

5.1.1 Alternative 1: No Action

The EPA is required by the NCP, 40 C.F.R. § 300.430(e)(6) to evaluate the No Action Alternative. The No Action Alternative may be appropriate at some sites where a removal action has already occurred that has reduced risks to human health and the environment. Although a remedial action is occurring at the Site, residual risks to human health remain as documented in the BHHRA. Under the No Action Alternative, the existing remedial action would cease. The concentrations of lead in residential property soils would remain at levels (i.e., lead concentrations greater than 400 ppm) that present a risk to human health, particularly for young children residing at the Site. The No Action Alternative is therefore not protective of human health.

5.1.2 Alternative 2: Excavation and Disposal

Under this alternative, residential property soils with at least one non-drip zone sample greater than 400 ppm lead will be excavated and disposed. Properties where only the drip zone soil exceeds 400 ppm lead would not be addressed under this action. Establishment and operation of a local lead hazard registry would be implemented to further control the residual risks associated with soil contamination below 400 ppm and other non-soil sources of lead. The existing soil sampling program would be continued to identify residential properties that require excavation. The EPA estimates that there are approximately 9,966 residential properties that contain soils with lead concentrations that exceed 400 ppm lead and have not been remediated. Excavated soil would be disposed at the existing sanitary landfill in Malvern, Iowa or at a new repository. The EPA is presently remediating the soil at approximately 1,000 properties per year and if the soil remediation continues at the existing pace, the remedial action would be completed in approximately 10 years. The time to implement this alternative could be shortened or lengthened by reducing or increasing the pace of soil remediation.

<u>Excavation</u>

This alternative includes the excavation and removal of soil, and backfilling the excavation with clean soil. Excavation of a property would be triggered when the highest mid-yard soil sample for the property contains greater than 400 ppm lead. Residential properties with at least one quadrant sample testing greater than 400 ppm for lead would have all quadrants exceeding 400 ppm and possibly the drip zones remediated. The drip zones would be remediated if the lead concentration is greater than 400 ppm.

Soil would be excavated using lightweight excavation equipment and hand tools in the portions of the property where the surface soil exceeds 400 ppm lead. Excavation would continue until reaching a residual lead concentration of less than 400 ppm in the initial one foot of excavation or less than 1,200 ppm at depths of greater than one foot. In garden areas, excavation would continue to a level of less than 400 ppm in the initial 2 feet of excavation or less than 1,200 ppm at depths greater than 2 feet. Fugitive dust would be controlled and monitored during soil excavation using dust suppression techniques.

Following excavation, clean fill and topsoil would be used to replace the soil removed, returning the property to its original elevation and grade. The EPA will not use soil from protected areas of Loess Hills as fill for the site.

Soil capping may be used as an acceptable alternative to, or in combination with, excavation to reduce cost in special cases such as large parks or schoolyards where placement of a cap would not create drainage problems. Capping in areas where surface soil-lead concentrations are greater than 400 ppm and less than 1,200 ppm would require a minimum of 12 inches of clean soil for the cap.

Vegetative Cover

After the topsoil has been replaced, the property would be sodded to restore the lawn. However, hydro-seeding or conventional seeding may be used in areas of properties with special considerations at the property owner's request.

Disposal

Three options are available to accommodate disposal of the excavated soils. The first option would be to haul the contaminated soil to an off-site sanitary landfill for use as daily cover and/or for disposal. Before the soil is hauled to the landfill, it is placed in a staging area and TCLP tests are conducted to ensure the soil is non-hazardous. To date, no soil samples from any staging area at the OLS have failed TCLP. This option is currently being used for an on-going remedial action at the site.

The second option would be to use the soil excavated from the residential properties as beneficial fill in the construction of a commercial or industrial facility. Lead-contaminated soils at the site are considered a risk to human health only in residential settings. Removed soils could be safely used in a commercial/industrial setting without creating a risk to human health. Constructed engineering features may also be necessary to protect the fill area. Long-term maintenance of any constructed engineering features would also be necessary.

Option three would consist of constructing a new repository on public or privately owned land. Public land would offer the advantage of control over future use of the property. Significant design and site preparation may be required for construction of the facility. This option is limited by the availability of land and willingness of landowners to maintain such a facility. This option would also be limited by the availability of land and willingness of landowners to maintain such a facility.

Exterior Lead-Based Paint

In order to prevent the re-contamination of the clean soil placed in properties after excavation, deteriorating exterior LBP may be stabilized on homes prior to or after the soil excavation in the properties. EPA has determined that there are no other parties with the capability or resources to address the recontamination threat posed by LBP.

Not all homes will require paint stabilization. Only those homes that are determined to have the potential for elevated soil lead levels to develop due to deteriorating LBP will be addressed. Paint would be stabilized using lead-safe work practices and all previously painted surfaces would be primed and repainted. The stabilization of exterior LBP will be conducted on a voluntary basis. Paint stabilization activities would only be offered at homes that are eligible for soil cleanup.

It is estimated that 14,577 sampled and unsampled properties will be eligible for paint assessments. The number of assessments performed to date is 2,894, leaving 11,683 additional properties that will eligible for paint assessments. Of the 2,894 completed assessments, 1,335 or 46 percent of the properties will be assumed to qualify for paint stabilization based on proposed eligibility criteria applied to completed LBP assessments at the 2,894 properties to date. There are an additional 133 properties that have been assessed and qualify for paint stabilization based on the proposed eligibility criteria, but have not been stabilized. It is estimated an additional 5,389 properties that have not been assessed will be eligible for paint stabilization based on proposed eligibility criteria applied to completed LBP assessments at the 2,894 properties to date.

Interior Lead Dust

At homes where soil cleanup actions are conducted, interior dust will be sampled to assess indoor lead exposure. Homes that exceed the EPA and HUD standards could undergo a one-time high-efficiency cleaning after the soil cleanup is completed at the property. Evidence suggests that lead based contamination dust can rapidly reaccumulate on household surfaces following dust removal (Ref. 28). Consequently, rather than providing a one time professional cleaning, HEPAVACs could be made available to the properties where soil cleanup is performed and lead concentrations in the dust exceed EPA/HUD criteria. Each homeowner at properties eligible for dust sampling would be provided information regarding household lead hazards and each homeowner receiving a HEPAVAC would be trained on the importance, use, and maintenance of the HEPAVAC.

For purposes of providing a cost estimate for this alternative it is assumed that a

HEPAVAC will be provided to homeowners whose homes exceed standards for interior dust. It is estimated that 14,577 properties are eligible for dust sampling (all properties eligible for soil remediation). It is assumed 50 percent of the 14,577 eligible properties will grant access to sample. Of the 7,289 properties that grant access, it is assumed for costing purposes that 20 percent (1,458 properties) will be eligible for interior dust response.

<u>Governmental Controls</u>

Local ordinances are being considered by the City of Omaha to address lead hazards in the OLS. If enacted, the proposed landlord certification ordinance would make it unlawful for any property owner to rent or allow the residential use by another person of a residential premise constructed prior to January 1, 1978, unless the property owner has provided the tenant with a written certification by a state-certified lead paint risk assessor that (1) indicates the premises have been tested for lead paint and were found to not contain lead paint on any interior or exterior surface or (2) any lead dust found on the premises meets the standards of HUD regarding the presence of lead dust on window sills, window troughs, and floors, and that none of the lead paint on or within the premises is flaking, cracking, peeling, scaling, blistered, chipped, or loose.

A second ordinance under consideration by the City of Omaha would make it a nuisance to maintain or allow any open or exposed surface in any dwelling which is coated with, or consists of, or contains any lead-bearing substance if the surface is accessible or may become accessible to ingestion or inhalation by any person.

Although these proposed ordinances could effectively reduce the potential for exposure to lead hazards at residential properties at the OLS, these measures will not be carried forward as elements of a remedial alternative. EPA supports the enactment of these ordinances and recognizes their potential benefit, but EPA does not have authority to ensure passage of the local ordinances and therefore can not assure their implementation.

<u>Informational Devices</u>

Information devices that could be implemented at the OLS site include operation of a local registry containing lead hazard information on properties in the OLS. The registry would be operated by the City of Omaha and would include information concerning the lead hazards at properties. Information maintained in the registry may include, but not be limited to, whether lead concentrations in the soil at a property exceed the action levels, and if so, whether the soil has been remediated; whether a LBP paint assessment has been performed and stabilization has been completed, if necessary; and any certifications that are made in accordance with the local proposed ordinances previously discussed.

Public Health Education

The present ongoing lead hazard education program in Omaha would be continued through completion of the remedial action in cooperation with ATSDR, NDEQ, and the Douglas County Health Department (DCHD). The existing 2 public information centers located at 3040 Lake Street and 4911 S. 25th Street in Omaha, Nebraska would continue to operate until the remedial action is completed. The public information centers would continue to distribute written information on controlling lead hazards and respond to questions from the public concerning EPA response activities.

Public health education activities providing community education through distribution of fact sheets containing information on controlling lead exposure would be continued. The EPA would continue providing lead hazard information to the public through public media (television, radio, newspapers, internet).

5.1.3 Alternative 3: Phosphate Stabilization; Excavation and Disposal

This alternative involves a combination of excavation and phosphate stabilization of residential soils and high child impact areas found to contain lead concentrations above 400 ppm. An estimated 9,966 properties have lead concentrations greater than 400 ppm. Because the bench-scale treatability study indicated that the bioavailability of lead would only be reduced by an average of 20 percent, it is assumed that a phosphate amendment could only be effective at reducing risks associated with lead concentrations in the soils by 20 percent. Consequently, phosphate stabilization would only be conducted on soils with lead concentrations above 400 ppm but less than 500 ppm. Residential properties with lead concentrations above 500 ppm lead would be excavated as described in Alternative 2.

The total number of residential properties with lead concentrations above 400 ppm and below the effective stabilization level of 500 ppm is estimated to be approximately 3,721 properties. There are an estimated 3,234 properties that have been sampled and have lead concentrations between 400 and 500 ppm. Of the remaining 5,210 properties that have not been sampled, 487 (9.3%) properties were estimated to have lead concentrations between 400 and 500 ppm based on completed soil sampling at the OLS. The remaining 6,245 properties would be remediated as described in Alternative 2.

In addition, this alternative includes all other activities described in Alternative 2, including public information and education, exterior lead-based paint stabilization, and interior dust response.

Phosphate Stabilization

Under this alternative, all residential properties and residential-type properties (i.e., child care facilities, parks, and playgrounds) with lead concentrations exceeding 400 ppm, but less than 500 ppm (the assumed concentration for costing purposes), would be treated with a phosphate amendment to reduce the bioavailability of metals in the soil, thereby controlling the health risk to children. The bench-scale treatability study performed on the OLS soils indicated that 1.5 phosphoric acid (PA) (weight, % P) would be the most effective amendment for reducing the bioavailability of lead in soils. Consequently, this alternative will assume the phosphate amendment that is used will be 1.5 PA. This alternative would involve stabilizing metals in the soil by adding phosphate into the soil to a depth of 6 to 10 inches. It is anticipated that the phosphate, in the form of phosphoric acid, would be roto-tilled into the soil, and allowed to stabilize for a few days. Then lime would be added to the soil to raise the pH, and the lawn would be re-established. Fencing would be installed and remain in place from the time of phosphoric acid application until the pH of property is return to a neutral pH. Stabilization of a property would be performed on properties when the highest measured non-drip zone sample for the property is greater than 400 ppm lead, but less than the effective stabilization level (assumed to be 500 ppm for cost purposes.)

A long-term monitoring program would be instituted to assess the effectiveness of phosphate stabilization. The program would include soil chemistry monitoring to assess the effects of natural weathering and the long-term stability of the lead-phosphate minerals formed during phosphate treatment. For costing purposes, 10 percent of the properties remediated using phosphate stabilization will be tested at 6 months, 2 years, and 5 years. The final decision to proceed with phosphate stabilization of properties will be made by the EPA after peer review and assessment of the bench scale treatability study and public comments on this Final FS Report.

Excavation

As with Alternative 2, this alternative includes the excavation and removal of soil, and backfilling the excavation with clean soil. Excavation of a property would be triggered when the highest mid-yard soil sample for the property contains greater than 500 ppm lead. Residential properties with at least one mid-yard quadrant sample testing greater than 500 ppm for lead would have all quadrants exceeding 400 ppm and possibly the drip zones remediated. The drip zones would be remediated if the lead concentration is greater than 400 ppm.

Soil would be excavated at properties with a high mid-yard soil lead concentration exceeding 500 ppm using lightweight excavation equipment and hand tools in the portions of the property where the surface soil exceeds 400 ppm lead. Excavation would continue until reaching a residual concentration of less than 400 ppm in the initial one foot of excavation or less than

1,200 ppm at depths of greater than one foot. In garden areas, excavation would continue to a level of less than 400 ppm in the initial 2 feet of excavation or less than 1,200 ppm at depths greater than 2 feet. Fugitive dust would be controlled and monitored during soil excavation using dust suppression techniques.

Following excavation, clean fill and topsoil would be used to replace soil removed, returning the property to its original elevation and grade. The EPA will not use soil from protected areas of Loess Hills as fill for the site.

Soil capping may be used as an acceptable alternative to, or in combination with, excavation to reduce cost in special cases such as large parks or schoolyards where placement of a cap would not create drainage problems. Capping in areas where surface soil-lead concentrations are greater than 400 ppm and less than 1,200 ppm would require a minimum of 12 inches of clean soil for the cap.

<u>Vegetative Cover</u>

After the topsoil has been replaced, the property would be sodded to restore the lawn. However, hydro-seeding or conventional seeding may be used in areas of properties with special considerations at the property owner's request.

<u>Disposal</u>

Three options are available to accommodate disposal of the excavated soils. The first option would be to haul the contaminated soil to an off-site sanitary landfill for use as daily cover and/or for disposal. Before the soil is hauled to the landfill, it is placed in a staging area and TCLP tests are conducted to ensure the soil is non-hazardous. To date no soil samples from any staging area at the OLS have failed TCLP. This option is currently being used for the on-going remedial action at the site.

The second option would be to use the soil excavated from the residential properties as beneficial fill in the construction of a commercial or industrial facility. Lead-contaminated soils at the site are considered a risk to human health only in residential settings. Removed soils could be safely used in a commercial/industrial setting without creating a risk to human health. Constructed engineering features may also be necessary to protect filled areas. Long-term maintenance of any constructed engineering features would also be necessary.

Option three would consist of constructing a new repository on public or privately owned land. Public land would offer the advantage of control over future use of the property. This alternative may have significant costs associated with design and site preparation would be required for construction of the facility. This option would also be limited by the availability of land and willingness of landowners to maintain such a facility.

Exterior Lead-Based Paint

In order to prevent the re-contamination of the clean soil placed in properties after excavation, deteriorating exterior LBP paint may be stabilized on homes prior to or after the soil excavation in the properties. EPA has determined that there are no other parties with the capability or resources to address the recontamination threat posed by LBP. The stabilization of exterior LBP would be conducted on a voluntary basis.

Not all homes will require paint stabilization. Only those homes that are determined to have the potential for elevated soil lead levels to develop due to deteriorating LBP will be addressed. Paint would be stabilized by using lead-safe work procedures and all previously painted surfaces would be primed and repainted. Exterior paint stabilization activities would only occur at homes that are eligible for soil cleanup.

It is estimated that 14,577 sampled and unsampled properties will eligible for paint assessments. The number of assessments performed to date is 2,894, leaving 11,683 properties that are eligible for paint assessments. Of the 2,894 completed assessments, 1,335 or 46 percent of the properties will be assumed to qualify for paint stabilization based on proposed eligibility criteria applied to completed LBP assessments at the 2,894 properties to date. There are an additional 133 properties that have been assessed and qualify for paint stabilization based on the proposed eligibility criteria, but have not been stabilized. It is estimated an additional 5,389 properties that have not been assessed will be eligible for paint stabilization based on proposed eligibility criteria applied to completed LBP assessments at the 2,894 properties to date.

Interior Lead Dust

At homes where soil cleanup actions are conducted, interior dust will be sampled to assess indoor lead exposure. Homes that exceed the EPA and HUD standards could undergo a one-time high-efficiency cleaning. The interior cleaning could be conducted on a voluntary basis for willing homeowners, after the soil cleanup is completed at the property. Evidence suggests that lead based contamination dust can rapidly reaccumulate on household surfaces following dust removal (Ref. 28). Consequently, rather than providing a one time professional cleaning, HEPAVACs could be made available to the properties where soil cleanup is performed and lead concentrations in the dust exceed allowable criteria. Each homeowner at properties eligible for dust sampling would be provided information on household lead hazards and each homeowner receiving a HEPAVAC would be trained on the importance, use, and maintenance of the HEPAVAC. For purposes of providing a cost estimate for this alternative it is assumed that a HEPAVAC will be provided to residents whose homes exceed EPA/HUD standards for interior dust.

It is estimated that 14,577 properties are eligible for dust sampling (all properties eligible for soil remediation), and that 50 percent of the 14,577 eligible properties will grant access to sample. Of the 7,289 properties that grant access, it is assumed for costing purposes that 20 percent (1,458 properties) will be eligible for interior dust response.

Governmental Controls

Two local ordinances are currently under consideration by the City of Omaha to address lead hazards in the OLS. One ordinance under consideration would make it unlawful for any property owner to rent or allow the residential use by another person of a residential premise constructed prior to January 1, 1978, unless the property owner has provided the tenant with a written certification by a state-certified lead paint risk assessor that (1) indicates the premises have been tested for lead paint and were found to not contain lead paint on any interior or exterior surface or (2) any lead dust found on the premises meets the standards of HUD regarding the presence of lead dust on window sills, window troughs, and floors, and that none of the lead paint on or within the premises is flaking, cracking, peeling, scaling, blistered, chipped, or loose.

The second ordinance under consideration by the City of Omaha would make it a nuisance to maintain or allow any open or exposed surface in any dwelling which is coated with, or consists of, or contains any lead-bearing substance if the surface is accessible or may become accessible to ingestion or inhalation by any person.

Although these proposed ordinances could effectively reduce the potential for exposure to lead hazards at residential properties at the OLS, these measures will not be carried forward as elements of a remedial alternative. EPA supports the enactment of these ordinances and recognizes their potential benefit, but EPA does not have authority to ensure passage of the local ordinances and therefore can not assure their implementation.

Informational Devices

Information devices that will be implemented at the OLS site include operation of a local registry containing lead hazard information on properties in the OLS. The registry would be operated by the City of Omaha and would include information concerning the lead hazards at properties. Information maintained in the registry may include, but not be limited to, whether lead concentrations in the soil at a property exceed the action levels, and if so, whether the soil has been remediated; whether a LBP paint assessment has been performed and stabilization has been completed, if necessary; and any certifications that are made in accordance with the local proposed ordinances previously discussed.

Public Health Education

The current lead hazard education program would be continued through completion of the remedial action in cooperation with the ATSDR, NDEQ, and the DCHD. The existing 2 public information centers located at 3040 Lake Street and 4911 S. 25th Street in Omaha, Nebraska would continue to operate until the remedial action is completed. The public information centers would continue to distribute written information on controlling lead hazards and respond to questions from the public concerning EPA response activities.

The public health education program that includes providing community education through distribution of fact sheets containing information on controlling lead exposure would be continued. The EPA would continue providing lead hazard information to the public through public media (television, radio, newspapers, internet).

6.0 Detailed Evaluation of Remedial Alternatives

The NCP, 40 C.F.R. Section 300 et. seq., requires the EPA to evaluate selected remedial alternatives against nine criteria. A selected or preferred alternative should best satisfy all nine criteria before it can be implemented. The first step is to ensure that the selected remedy satisfies the threshold criteria. The two threshold criteria are overall protection of public health and the environment and compliance with ARARs. In general, alternatives that do not satisfy these two criteria are rejected and not evaluated further. However, compliance with ARARs may be "waived" if site-specific circumstances warrant such a "waiver" as described in Section 300.430(f)(1)(ii)(C) of the NCP, 40 C.F.R. § 300.430(f)(1)(ii)(C). No ARAR waivers are contemplated for any of the alternatives evaluated in this FS.

The second step is to compare the selected remedy against a set of balancing criteria. The NCP establishes five balancing criteria, which include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; implementability; short-term effectiveness; and cost. The third and final step is to evaluate the selected remedy on the basis of modifying criteria. The two modifying criteria are state and community acceptance. These final two criteria cannot be evaluated fully until the state and public have commented on the alternative and their comments have been analyzed.

6.1 Alternative Analysis Criteria

Each of the alternatives is subjected to nine evaluation criteria described in the NCP. The factors considered for each evaluation criterion and a brief description of each criterion follows:

6.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance With ARARs

This criterion is used to decide how each alternative meets applicable or relevant and appropriate federal and state requirements, as defined in CERCLA Section 121. Compliance is judged with respect to:

- chemical-specific ARARs
- action-specific ARARs
- location-specific ARARs
- appropriate criteria, advisories and guidance

Potential chemical- and location-specific ARARs are identified in Tables 2-1 through 2-4. Potential federal and state action-specific ARARs relating to the remedial alternatives are identified in Tables 6-1 and 6-2.

6.1.2 Balancing Criteria

Long-Term Effectiveness

This criterion addresses the results of a remedial action in terms of the risk remaining at the site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include:

- magnitude of risk remaining at the site after the remedial objectives are met,
- adequacy of controls, and
- reliability of controls (i.e., assessment of potential failure of the technical components).

Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction and operation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to:

- protection of community during remedial actions,
- protection of workers during remedial actions,
- time until remedial response objectives are achieved, and
- environmental impacts.

Table 6-1
Potential Federal Action-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Disposal of Solid Waste in a Permanent Repository and closure of the Repository.	Subtitle D of RCRA, Section 1008, Section 4001, et seq., 42 U.S.C. §6941, et seq.	State or Regional Solid Waste Plans and implementing federal and state regulations to control disposal of solid waste. The yard soils disposed in the repository may not exhibit the toxicity characteristic and therefore, are not hazardous waste. However, these soils may be solid waste.	Contaminated residential soils will be consolidated from yards throughout the site into a single location. The disposal of this waste material should be in accordance with regulated solid waste management practices.
2. Disposal of Hazardous Waste in the Permanent Repository and Designation as a Corrective Action Management Unit (CAMU).	Subtitle C of RCRA, Section 3001 et seq., 42 U.S.C. §6921, et seq. and implementing regulations at 40 C.F.R. Subpart S, Corrective action for solid waste management units and temporary units, 40 C.F.R. §264.522	RCRA defines CAMUs to be used in connection with implementing remedial measures for corrective action under RCRA or at Superfund sites. Generally, a CAMU is used for consolidation or placement of remediation wastes within the contaminated areas at the facility. Placement of wastes in a CAMU does not constitute land disposal of hazardous waste and does not constitute creation of a unit subject to minimum technology requirements.	The RCRA requirements of Subtitle C are not applicable to the disposal of residential yard soils in the repository. Residential yard soils contaminated from smelter fall out are not excluded from regulation under the RCRA exclusion for extraction, beneficiation and mineral processing. Therefore, yard soils exhibiting a RCRA toxicity characteristic would be regulated under Subtitle C of RCRA. However, because of the CAMU regulation, these residential soils are remediation wastes and may be disposed without triggering RCRA disposal requirements. The remedial action will comply with the requirements of the CAMU rule.

Table 6-1, Continued
Potential Federal Action-Specific ARARs

	Citation	Prerequisite	Requirement
B. Relevant and Appropriate Requirements			
1. NPDES Storm Water Discharge for Permanent Repository.	40 C.F.R. Part 122, § 122.26	Establishes permitting process and discharge regulations for storm water	Required management of repository where waste materials come into contact with storm water. Also required during construction of the repository.
2. Transportation of excavated soils.	DOT Hazardous Material Transportation Regulations, 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous wastes.	Relevant and appropriate for the excavation alternative which would transport wastes on-site.
C. To Be Considered	None		

Table 6-2
Potential State Action-Specific ARARs

	Citation	Prerequisite	Requirement
A. Applicable Requirements			
1. Fugitive dust control measures to be utilized during excavation activities	Nebraska Department of Environmental Quality – TITLE 129 Air Quality Regulations, Chapter 32	Requires operating and construction permits to provide that reasonable measures be used to prevent particulate emissions from leaving the premises. Also, sets ambient air quality standards for a number of air constituents.	Recommend that excavation of yard soils or tilling of yards in treatment alternative be handled in such a manner as to control fugitive emissions, such as use of a water spray during excavation, tilling or transportation. May be used in monitoring ambient air quality during implementation for lead and other particulates.
2. Solid waste management regulations	Nebraska Department of Environmental Quality – TITLE 132 – Integrated Solid Waste Management Regulations	Requires permits for proper identifications and disposal of solid waste in municipal solid waste disposal areas.	Requires specified procedures for the location, design, operation, and ground water monitoring, closure, post closure, and financial assurance for solid waste disposal facilities. Requires specific procedures for special waste management.
3. Siting Procedures and Policies	Nebraska State Statutes 13-1701 to 13-1714	Policies and procedures are required in order to get approval for a solid waste disposal area.	Requires approvals by local jurisdictions prior to the development of a site as a solid waste disposal area.
B. Relevant and Appropriate Requirements			
1. Nebraska Surface Water Quality Standards	Nebraska Department of Environmental Quality - TITLE 117	Regulates the discharge of constituents from any point source, including stormwater, to surface waters of the state. Provides for maintenance and protection of public health and aquatic life uses of surface water and groundwater.	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges.
2. Rules and Regulations pertaining to the issuance of permits under the National Pollutant Discharge Elimination System	Nebraska Department of Environmental Quality - TITLE 119	Defines and issues permits for the discharge of constituents from any point source, including storm water, to surface waters of the state. Establishes development of an approved action plan and discharge regulations for storm water	Required for protection of wetlands, streams, lakes, and impounded waters from the runoff from toxic discharges. Required of management of repository where waste materials come into contact with storm water. Also required during construction of the repository. Monitoring program shall be implemented to ensure compliance with discharge regulations.
C. To Be Considered			
1. Hazardous waste handling, transport and disposal regulations	Nebraska Department of Environmental Quality – TITLE 128 Nebraska Hazardous Waste Regulations	Requires operating permits for proper identifications, handling, transport, and disposal of hazardous materials.	Supplement the federal RCRA regulations and define state permitting requirements.

Table 6-2, Continued
Potential State Action-Specific ARARs

	Citation	Prerequisite	Requirement
2. Siting Procedures and Polices	Nebraska State Statues 81-1521.08 to 81-1521.23	Policies and procedures are required in order to get approval for a hazardous waste management facility	Requires approval by local jurisdictions prior to the development of a site as a hazardous waste management facility.

Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contaminants. The factors to be evaluated include:

- treatment process and remedy,
- amount of hazardous material destroyed or treated,
- reduction in toxicity, mobility or volume of the contaminants,
- irreversibility of the treatment, and
- type and quantity of treatment residuals.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers:

- the ability to construct technology,
- reliability of technology,
- ease of undertaking additional remedial actions if necessary,
- monitoring considerations,
- coordination with other agencies (e.g., state and local) to obtain permits or approvals for implementing remedial actions,
- availability of treatment, storage capacity, and disposal services,
- availability of necessary equipment and specialists, and
- availability of prospective technologies.

Cost

This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared based on a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life. As suggested in the EPA's guidance, a discount rate of 7 percent will be applied. The cost estimates are expected to provide an accuracy of +50 percent to -30 percent.

6.1.3 Modifying Criteria

<u>State Acceptance</u>

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the state supports, reservations of the state, and opposition of the state.

<u>Community Acceptance</u>

This criterion incorporates public concerns into the evaluation of the remedial alternatives. Typically, community acceptance cannot be determined during development of the FS. Evaluation of this criterion will be completed when the final FS and Proposed Plan have been released for review by the public. This criterion will then be addressed in the final ROD and the responsiveness summary.

6.2 Alternative Analysis

The following sub-sections present the individual analyses of the alternatives against the nine criteria.

6.2.1 Alternative 1: No Action

<u>Overall Protection of Human Health and the Environment</u>

This alternative does not provide protection for the environment or residents in Omaha because no actions are taken to mitigate the exposure to lead-contaminated soil.

<u>Compliance With ARARs</u>

The location-specific and action-specific ARARs are not applicable to this alternative. This alternative would not meet federal To Be Considered criteria. EPA (40 CFR Part 745) and HUD (24 CFR Part 35) regulations that include LBP hazard prevention standards would not be met. Lead concentrations in indoor dust would continue to exceed lead-hazard criteria in these regulations. As discussed in the BHHRA, an estimated 9,033 properties (32% of properties evaluated) would continue to have P10 values at or below the EPA health-based goal of 5%.

Long-Term Effectiveness

This alternative provides no effectiveness for the protection of health and environment over the long term. The public is still exposed to elevated levels of lead.

Short-Term Effectiveness

No risk is imposed on the remedial action workers during the short term. The public and environment are still exposed to the same levels of lead.

Reduction of Toxicity, Mobility, or Volume

There is no reduction in the toxicity, mobility, or volume of contamination under the No Action alternative.

Implementability

This alternative does not require implementation.

Cost

There would be no costs associated with the No Action alternative.

State Acceptance

It is assumed that this alternative would not be acceptable to the state.

Community Acceptance

The level of public awareness and involvement at the site indicates that this alternative would not be acceptable to the community.

6.2.2 Alternative 2: Excavation and Disposal

Overall Protection of Human Health and the Environment

Exposure to lead-contaminated soil is a significant health risk posed by the site. Residential soils have been identified as a primary contributor to risk associated with lead exposures at the OLS. In order to reduce exposure to lead and the associated risks, the excavation alternative replaces lead-contaminated residential soils with clean soils, thereby breaking the exposure pathway between lead-contaminated soils and children.

In order to prevent the re-contamination of the clean soil placed in properties after excavation, deteriorating exterior LBP may be stabilized on homes prior to or after the soil excavation in the properties. Only those homes that are determined to threaten the continued effectiveness of soil remediation due to deteriorating LBP will be addressed. Paint stabilization would follow lead safe work practices.

Household dust has also been identified as a lead exposure pathway. Residential soils are a contaminant source for house dust. Thus, remediating residential soils would reduce a contamination pathway to home interiors. Interior dust above the action level for wipe samples will be controlled in homes where soil is remediated. HEPAVACs and health education would be made available to residents at the properties that exceed the 400 ppm cleanup level when wipe sampling identifies interior dust levels that exceed EPA/HUD criteria.

Sanitary landfills, controlled fill areas, and soil repositories can be designed and engineered to protect human health and the environment, including controlling migration of contaminants into ground water and surface water. With appropriate precautions taken during staging and hauling of the soil, there will be no unacceptable impact associated with implementation of the excavation and soil replacement elements of this alternative.

This alternative would control the significant exposure pathways associated with contaminated residential soils. Once residential soils excavation, soil replacement, and revegetation is complete, the soils are properly disposed, the information registry is implemented, and the ongoing education program is continued, risks associated with lead-contaminated residential soils will be controlled. Therefore, the excavation and replacement of contaminated soils is protective of human health and the environment.

Compliance With ARARs & Potential Action-Specific ARARs

As discussed previously, there are no promulgated laws or standards for lead-contaminated soil. A preliminary site-specific action level of 400 ppm for lead in soils is being advanced in this Final FS to provide for the protection of human health at this site based on information from the BHHRA which constitutes a To Be Considered criterion. EPA and HUD regulations for interior dust levels are To Be Considered criteria and would be used to trigger interior dust response properties where interior dust sampling identifies dust lead levels that exceed the applicable criteria.

Alternative 2 would comply with the chemical- and location-specific ARARs and To Be Considered criteria identified in Section 2 and presented in Tables 2-1 through 2-4. Alternative 2 would comply with Executive Orders 11988 and 11990 because the soil repository used during the remedial action would not be located within a flood plain or wetland. Because there would not be any structures constructed in waterways or in areas of critical habitat to threatened or endangered species, Alternative 2 would comply with the Endangered Species Act and the Rivers and Harbors Act. Excavation of residential properties would be performed in a manner to minimize the effect on historic landmarks in the OLS and would comply with the National Historic Preservation Act.

The potential federal and state action-specific ARARs for the excavation alternative are identified in Tables 6-1 and 6-2. The excavation and disposal alternative would comply with action-specific ARARs. The principal action-specific ARARs for this alternative are the requirements for proper transport and disposal of the excavated soils. Soils will continue to be tested to determine whether they are a hazardous waste and, if determined to be hazardous, would be transported and disposed in an appropriate final management facility in accordance with U.S. Department of Transportation and EPA regulations in 49 CRF Parts 171-177 and 40 CFR Parts 263 and 264.

The remedial action would comply with requirements of the Clean Water Act. Storm water discharge permits requirements are not applicable to excavation of residential properties since excavation of residential properties would not disturb more than one acre. Landfills, controlled fills, or repositories where the excavated soil is disposed would comply with the discharge permit regulations in 40 CFR Part 122.

Fugitive dust control measures such as the application of water would be implemented at residential properties during the remedial action to comply with Title 129, Chapter 32 of the NDEQ regulations regarding dust control.

Long-Term Effectiveness

The residual risks (the risk remaining after implementation) would be significantly reduced under this alternative. Residential properties with the highest mid-yard lead concentrations greater than 400 ppm would have the soil removed until reaching a residual concentration of less than 400 ppm in the initial one foot of excavation or less than 1,200 ppm at depths of greater than one foot. In garden areas, excavation would continue to less than 400 ppm in the initial 2 feet of excavation or less than 1,200 ppm at depths greater than 2 feet. The removal of contaminated soil, replacement with clean backfill, and revegetation ensures that future potential for exposure will be significantly reduced.

Short-Term Effectiveness

This alternative is protective in the short term. Although lead-laden dust could be generated during excavation, dust suppression would be implemented for the protection of community and workers during the remedial action. The alternative would be lengthy to implement for all affected residences, requiring several years to complete. The average length of time to complete all elements of soil replacement and restoration at any one residence could be several weeks; however residential exposure to dust would be minimal since dust suppression would be implemented when disturbance of contaminated soil is occurring.

Contaminated soils would continue to be used as daily cover in a sanitary landfill, used as beneficial fill, or placed in a permanent repository. Disposal of the soil in a landfill or repository would have no negative environmental impacts provided storm water controls and other design and engineering controls are achieved and maintained.

Reduction of Toxicity, Mobility, or Volume

This alternative would significantly reduce the mobility of the contaminants of concern by consolidation of the contaminated soils in a landfill or other disposal area. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced. Proper maintenance at the existing sanitary landfill or construction and long term maintenance of a controlled fill area or soil repository are important components of this alternative that ensure a significant reduction of mobility.

Implementability

This alternative is readily implementable. Excavation methods, backfilling, and revegetation are typical engineering activities. Experience gained during previous EPA response actions has shown that this action is readily implementable. The information and education components of this alternative are implementable, but require cooperation and action by the local government entities.

Cost

This alternative is expected to have approximate capital costs of $226.7 million, as shown on Table 6-3, based on the estimate of $13,000 per home for excavation, transport, backfilling, dust suppression and lawn restoration. The overall cost includes $129.6 million for excavation, transport, backfilling, dust suppression and lawn restoration.

Table 6-3
Alternative 2 - Cost Analysis for Excavation and Disposal
Present Worth Cost Estimate
Omaha Lead Site Final FS Report

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
Mobilization [1]	1	Mob	$50,000	$50,000	
Obtain Soil and LBP Access/Soil Sampling [1]	5,210	Properties	$400	$2,084,000	
Material Movement (excavation, transport, backfill, dust suppression, and sodding) [2]	9,966	Properties	$13,000	$129,558,000	
Post Cleanup Reports [1]	9,966	Properties	$100	$996,600	
Paint Assessment	11,683	Properties	$210	$2,453,430	
Exterior Lead-based Paint Stabilization [2]	5,522	Properties	$4,000	$22,088,000	
Preparation of Health and Safety Plan	40	HR	$100	$4,000	
Preparation of QA/Sampling Plan	60	HR	$100	$6,000	
DIRECT CAPITAL COST SUBTOTAL				$157,240,030	
Bid Contingency (15%)				$23,586,000	
Scope Contingency (10%)				$15,724,000	
TOTAL DIRECT CAPITAL COST				$196,550,030	
Permitting and Legal (2%)				$3,931,000	
Construction Services (10%)				$19,655,000	
CONSTRUCTION COSTS TOTAL				$220,136,030	
Engineering Design (3%)				$6,604,100	
TOTAL CAPITAL COST				$226,740,000	
TOTAL ANNUAL CAPITAL COSTS[3]				$22,674,000	
ANNUAL COSTS					
Year 1					
Information Dissemination via Mass Media, Including Television	1	LS	$150,000		$150,000
Establish Information Registry	1	LS	$100,000		$100,000
Public Health Education	1	LS	$250,000		$250,000
Maintain 2 Public Information Centers	1	LS	$156,000		$156,000
Property Access/Indoor Dust Wipe Sampling	729	Properties	$100		$72,900
Interior Dust Response Outreach	729	Properties	$90		$65,610
Purchase HEPAVAC	146	Properties	$350		$51,100
HEPAVAC instructions	146	HR	$90		$13,140
Year 2-10					
Information Dissemination via Mass Media, Including Television	1	LS	$150,000		$150,000
Maintain Information Registry	1	LS	$100,000		$100,000
Public Health Education	1	LS	$250,000		$250,000
Maintain 2 Public Information Centers	1	LS	$156,000		$156,000
Property Access/Indoor Dust Wipe Sampling	729	Properties	$100		$72,900
Interior Dust Response Outreach	729	Properties	$90		$65,610
Purchase HEPAVAC	146	Properties	$350		$51,100
HEPAVAC instructions	146	HR	$90		$13,140
TOTAL PRESENT WORTH COST				$165,285,000	

7 percent discount rate used to calculate present worth.

HR - Hours

LS - Lump Sum

FT - Feet

EA - Each

1 - BVSPC 2004 (Ref. 25)
2 - Costs Provided by EPA based on historical costs at the OLS
3 - Total Annual Capital Costs each year for 10 years

Table 6-3 (Continued)

Alternative 2 - Cost Analysis for Excavation and Disposal
Present Worth Cost Estimate
Omaha Lead Site Final FS Report

Year	Annual Capital Costs	Annual Costs	Total Annual Costs	Intermittent Costs Include:
1	$22,674,000	$858,750	$23,532,800	
2	$22,674,000	$858,750	$23,532,800	
3	$22,674,000	$858,750	$23,532,800	
4	$22,674,000	$858,750	$23,532,800	
5	$22,674,000	$858,750	$23,532,800	
6	$22,674,000	$858,750	$23,532,800	
7	$22,674,000	$858,750	$23,532,800	
8	$22,674,000	$858,750	$23,532,800	
9	$22,674,000	$858,750	$23,532,800	
10	$22,674,000	$858,750	$23,532,800	
11		$0	$0	
12		$0	$0	
13		$0	$0	
14		$0	$0	
15		$0	$0	
16		$0	$0	
17		$0	$0	
18		$0	$0	
19		$0	$0	
20		$0	$0	
21		$0	$0	
22		$0	$0	
23		$0	$0	
24		$0	$0	
25		$0	$0	
26		$0	$0	
27		$0	$0	
28		$0	$0	
29		$0	$0	
30		$0	$0	
Total Annual Costs			$235,328,000	
Present Worth of Annual Costs			$165,285,000	

Annual costs for Alternative 2 are shown in Table 6-3. The annual costs during years one through 10 are estimated to be approximately $858,750. The present worth value of Alternative 2 for the next 10 years is estimated to be $165.3 million. The cost estimate is within an accuracy range of +50 percent to -30 percent.

State Acceptance

State acceptance of the proposed alternative will be evaluated during the public comment period.

Community Acceptance

Community acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

6.2.3 Alternative 3: Phosphate Stabilization; Excavation and Disposal

Overall Protection of Human Health and the Environment

Treatment of soils with lead concentrations between 400 ppm and 500 ppm would control the primary threat to human health and the environment. Excavation of soils exceeding 400 ppm at properties with high mid-yard soil-lead concentrations greater than 500 ppm would permanently remove contaminated soil, thereby breaking the exposure pathway between lead-contaminated soils and children. Under Alternative 3, excavation would remove the potential for exposure to the most highly contaminated soils, and phosphate treatment of moderately contaminated soils will convert the lead into a form that would be less bioavailable, reducing risk to humans.

Phosphate stabilization has not been used on a full-scale basis to remediate lead-contaminated soils in a residential setting. The long-term effectiveness of phosphate treatment has not been demonstrated, and future soil chemistry testing of treated soils would be required to assure continued protectiveness of this process. The phosphate treatability study indicated that the bioavailability of lead can be reduced in OLS soils by approximately 20 percent. Thus, only those properties with lead concentrations between 400 ppm and 500 ppm would be remediated using phosphate treatment. The final decision to proceed with phosphate stabilization of properties will be made by the EPA after assessing public comment on the Final FS and the Proposed Plan.

In order to prevent the re-contamination of clean soil placed in properties after excavation, deteriorating exterior LBP may be stabilized on homes prior to or after the soil excavation in the properties. LBP stabilization will only be offered at properties where deteriorating LBP threatens the continued effectiveness of soil remediation, and will be voluntary to homeowners. LBP stabilization involves removing loose and flaking LBP from affected surfaces using lead-safe work practices, and priming and repainting of all previously painted surfaces.

Household dust has also been identified as a lead exposure pathway. Residential soils are a contaminant source to house dust. Thus, remediating residential soils would reduce a contamination pathway to home interiors. Interior dust above the action level for wipe samples will be controlled in homes where soil is remediated by providing HEPAVACs, training, and health education about household lead hazards to residents.

Sanitary landfill, controlled fill areas, and soil repositories can be designed and engineered to protect human health and the environment, including controlling migration of contaminants into ground water and surface water. With appropriate precautions taken during staging and hauling of the soil, there will be no unacceptable impact associated with implementation of the excavation and soil replacement elements of this alternative.

This alternative would break the significant exposure pathways associated with contaminated residential soils. Once residential soils are treated with the phosphate amendment; or removed through excavation and properly disposed, risks associated with lead-contaminated residential soils will be controlled. The phosphate stabilization and excavation and disposal alternative is protective of human health and the environment if the phosphate treatment significantly reduces the bioavailability of lead on a long term basis.

Compliance With ARARs

As discussed previously, there are no promulgated laws or standards for lead-contaminated soil. However, a preliminary site-specific action level of 400 ppm for lead in soils is being advanced in this Final FS to provide for the protection of human health at this site based on information from the BHHRA, which constitutes a To Be Considered criterion. Alternative 3 would comply with To Be Considered criteria if the phosphate treatment is effective in reducing the bioavailability of lead such that residential properties would not have P10 values exceeding the EPA health-based goal of 5 percent. In addition, EPA and HUD criteria for interior dust levels would be used to trigger interior dust response at properties where soil is remediated.

Alternative 3 would not comply with the To Be Considered criteria if the phosphate treatment was not effective in reducing the bioavailability of lead over a long period of time. Under these circumstances, some residential properties would continue to have P10 values at or below the EPA health-based goal of 5 percent. In addition, the alternative might not meet federal To Be Considered criteria in EPA (40 CFR Part 745) and HUD (24 CFR Part 35) regulations that address LBP poisoning prevention standards for LBP. Since soil-lead concentrations in treated soils would remain above 400 ppm, there may be an increased opportunity for lead concentrations in indoor dust samples from floors and window sills to exceed EPA/HUD criteria.

Alternative 3 would comply with the chemical- and location-specific ARARs and To Be Considered criteria identified in Section 2 and presented in Tables 2-1 through 2-4 if phosphate treatment remains effective. Alternative 3 would comply with Executive Orders 11988 and 11990 because the sanitary landfill, controlled fill, or soil repository used during the remedial action would not be located within a flood plain or wetland. Because there would not be any structures constructed in waterways or in areas of critical habitat to threatened or endangered species, Alternative 3 would comply with the Endangered Species Act and the Rivers and Harbors Act. Treatment and excavation of soil at residential properties would be performed in a manner to minimize the effect on historic landmarks in the OLS and would comply with the National Historic Preservation Act.

The potential federal and state action-specific ARARs for Alternative 3 are identified in Tables 6-1 and 6-2. Alternative 3 would comply with action-specific ARARs. Transportation of chemicals required for soil treatment, including the phosphoric acid, would be accomplished to comply with the U.S. Department of Transportation regulations at 49 CFR, Parts 171-177. Soils would continue to be tested to determine whether they are a hazardous waste and, if determined to be hazardous, would be transported and disposed in a final management facility in accordance with U.S. Department of Transportation and EPA regulations in 49 CRF Parts 171-177 and 40 CFR Parts 263 and 264.

Alternative 3 will comply with requirements of the Clean Water Act. Storm water discharge permits requirements are not applicable to excavation of residential properties since excavation of residential properties will not disturb more than one acre. Landfills or repositories where the excavated soil is disposed will comply with the discharge permit regulations in 40 CFR Part 122.

Title 117, Chapter 4 of the NDEQ regulations protects all surface waters from human-induced pollution which causes nuisance aquatic life (e.g., algal blooms). The treatability study conducted for the OLS indicated that the leachable phosphorous from soil is low following treatment with the phosphate amendment. However, if the leachable phosphorous increases over time, the phosphorous could leach to surface waters and contribute to algal blooms.

Fugitive dust control measures such as the application of water will be implemented at residential properties during the remedial action to comply with Title 129, Chapter 32 of the NDEQ regulations regarding dust control.

<u>Long-Term Effectiveness</u>

The residual risks (the risk remaining after implementation) would be significantly reduced under the excavation portion of this alternative. Soils exceeding 400 ppm would be treated to reduce risks at properties with high mid-yard soil lead levels between 400 and 500 ppm. Soils exceeding 400 ppm would be excavated and removed at properties with high mid-yard concentrations exceeding 500 ppm. Effective treatment of soils from 400-500 ppm and permanent removal of excavated soils ensure that potential for future exposure will be significantly reduced.

Data generated from treatability studies indicate phosphate-treated soils may reduce the bioavailability of lead in the soils by 20 percent on a short term basis. Phosphate stabilization of soils has not been implemented at a residential site and the long-term effectiveness of phosphate stabilization of lead in soils has not been completely demonstrated at the OLS or at other sites. Long-term monitoring would be required to demonstrate the long-term effectiveness of this alternative.

Short-Term Effectiveness

The phosphate stabilization alternative may present significant risks to residents, workers, and the community in the short term. Depending on the application method, there would be a risk to workers from aerosol spray during application of the phosphoric acid. Workers would be required to wear protective clothing, including respiratory protection, during the application of the phosphoric acid. Workers may be exposed to phosphoric acid during transfer of acid from the storage tanks to the transport trucks. There would be short-term risk to the public from transporting large volumes of phosphoric acid through residential neighborhoods.

During the first 7 to 10 days after the addition of the phosphoric acid, the soil would have a low pH near the surface which could cause skin irritation or burns and pose a hazard to human health. Application of the phosphoric acid could also damage the exterior of the house, shrubs, or personal property if the acid were not carefully applied to control aerosol dispersion. The property would have to be fenced prior to the application of the phosphoric acid to keep people and pets off of the property during treatment of the property. The fence would have to remain in place until the lime is applied to raise the pH of the soil. Small animals and birds would still have access to the property and contact with the soil prior to the application of the lime could pose a risk to them.

The excavation and disposal portion of this alternative is protective in the short term. Although lead-laden dust could be generated during the excavation, dust suppression would be implemented for protection of community and workers during remedial action. The alternative would be lengthy to implement for all affected residences, requiring several years to complete. The length of time to complete all elements of soil replacement and restoration could be several weeks; however residential exposure to dust would be minimal since dust suppression would be implemented during disturbance of contaminated soils.

The contaminated soils would continue to be used as a cover in a sanitary landfill or placed in a controlled fill or permanent repository. Disposal of the soil in a landfill, controlled fill, or repository would have no negative environmental impacts provided storm water controls and other appropriate design and engineering controls are achieved and maintained.

Reduction of Toxicity, Mobility, or Volume

The treatment portion of this alternative would reduce the toxicity and mobility of the contamination for those properties with lead contamination between 400 and 500 ppm. The volume of the contaminated soils would not be reduced. However, the amount of soil requiring excavation and disposal would be approximately 37 percent less than Alternative 2.

The excavation portion of this alternative would significantly reduce the mobility of the contaminants of concern by consolidation of the contaminated soils in the landfill or other disposal area. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced. Proper maintenance at the existing sanitary landfill or construction and long-term maintenance of a controlled fill or soil repository are important components of this alternative that ensure a significant reduction of mobility.

Implementability

This alternative would be implementable, although the phosphate treatment portion of the alternative would require careful planning. Phosphate application methods include the use of typical lawn or garden maintenance equipment. The application of the phosphoric acid treatment on residential properties has not been attempted on a large scale. This treatment alternative can cause skin irritation as well as damage to the respiratory system of workers if not handled properly. Phosphoric acid is viscous, making application difficult and it may crystallize in winter.

Assuming that approximately 916 gallons of phosphoric acid would be required to treat each property based on application rates from the bench scale treatability study, and assuming that 3,721 properties would require treatment, approximately 3.5 million gallons of acid would be required over the duration of the remedial action. Bulk storage facilities would be required and the phosphoric acid would have to be transported to the properties in vehicles. Additional risks to the public would include accidents involving the transport vehicles and chemical spills. If there is excess phosphoric acid, disposal of the excess acid will require the selection of a treatment and disposal facility or an agreement with the vendor to return the excess acid.

Excavation methods, backfilling, and revegetation are typical engineering activities. Phosphate treatment of residential soils has not been accomplished on a large scale in a residential area and may not be easily implemented. The information and education component of this alternative is implementable, but requires cooperation and action by the local government entities.

Cost

Table 6-4 presents the costs for Alternative 3. The excavation portion of this alternative is expected to have capital costs of $81.2 million, as shown on Table 6-4, based on the estimate of $13,000 per home for excavation, transport, dust suppression, backfilling and lawn restoration. The capital costs of phosphoric acid treatment and lawn restoration is $132.5 million.

The total capital cost for this alternative, including phosphate treatment and excavation, is estimated to be $347.6 million.

Annual costs for Alternative 3 are shown in Table 6-4. The annual costs for years one through 10 are estimated to be approximately $858,750. Annual costs for the long term monitoring program for the properties treated with the phosphate amendment are an additional $137,602 in years 2, 5, 10, 15, and 20. The present worth value of Alternative 3 is estimated to be $250.6 million. The cost estimate is within an accuracy range of +50 percent to -30 percent.

State Acceptance

State acceptance will be evaluated after the public comment period closes for the Proposed Plan and this FS.

Community Acceptance

Community acceptance will be completed after the public comment period closes for the Proposed Plan and this final FS.

Table 6-4
Alternative 3 - Cost Analysis for Phosphate Stabilization; Excavation and Disposal
Present Worth Cost Estimate
Omaha Lead Site Final FS Report

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
Mobilization [1]	1		$50,000	$50,000	
Obtain Soil and LBP Access/Soil Sampling [1]	5,210	Properties	$400	$2,084,000	
Material Movement (excavation, transport, backfill, dust suppression and sodding)[3]	6,245	Properties	$13,000	$81,185,000	
Post Cleanup Reports [1]	6,245	Properties	$100	$624,500	
Phosphoric Acid Treatment and Sod [2]	3,721	Properties	$35,596	$132,452,716	
Paint Assessment	11,683	Properties	$210	$2,453,430	
Exterior Lead-based Paint Stabilization [1]	5,522	Properties	$4,000	$22,088,000	
Long-Term Monitoring Program for Phosphate Treated Properties (10% of total properties at 6 months)	372	Sampling Events	$344	$128,002	
Long-Term Monitoring Reports	1	Reports	$9,600	$9,600	
Preparation of Health and Safety Plan	40	HR	$100	$4,000	
Preparation of QA/Sampling Plan	60	HR	$100	$6,000	
DIRECT CAPITAL COST SUBTOTAL				$241,085,248	
Bid Contingency (15%)				$36,162,800	
Scope Contingency (10%)				$24,108,500	
TOTAL DIRECT CAPITAL COST				$301,356,548	
Permitting and Legal (2%)				$6,027,100	
Construction Services (10%)				$30,135,700	
CONSTRUCTION COSTS TOTAL				$337,519,348	
Engineering Design (3%)				$10,125,600	
TOTAL CAPITAL COST				$347,645,000	
TOTAL ANNUAL CAPITAL COSTS[4]				$34,764,500	
ANNUAL COSTS					
Year 1					
Information Dissemination via Mass Media, Including Television	1	LS	$150,000		$150,000
Establish Information Registry	1	LS	$100,000		$100,000
Public Health Education	1	LS	$250,000		$250,000
Maintain 2 Public Information Centers	1	LS	$156,000		$156,000
Property Access/Indoor Dust Wipe Sampling	729	Properties	$100		$72,900
Interior Dust Response Outreach	729	Properties	$90		$65,610
Purchase HEPAVAC	146	Properties	$350		$51,100
HEPAVAC instructions	146	HR	$90		$13,140
Year 2-10					
Information Dissemination via Mass Media, Including Television	1	LS	$150,000		$150,000
Maintain Information Registry	1	LS	$100,000		$100,000
Public Health Education	1	LS	$250,000		$250,000
Maintain 2 Public Information Centers	1	LS	$156,000		$156,000
Property Access/Indoor Dust Wipe Sampling	729	Properties	$100		$72,900
Interior Dust Response Outreach	729	Properties	$90		$65,610
Purchase HEPAVAC	146	Properties	$350		$51,100
HEPAVAC instructions	146	HR	$90		$13,140
Long-Term Monitoring Program for Phosphate Treated Properties (10% of total properties at 2, 5, 10, 15, and 20 years)	372	Sampling Events	$344		$128,002
Long-Term Monitoring Reports at Years 2, 5, 10, 15, and 20 years	1	Reports	$9,600		$9,600
TOTAL PRESENT WORTH COST				$250,577,000	

EA - Each
LS - Lump Sum
FT - Feet
HR - Hour
1 - BVSPC 2004 (Ref. 25)
2 - Appendix A
3 - Costs Provided by EPA based on historical costs at the OLS
4 - Total Annual Capital Costs each year for 10 years

Table 6-4 (Continued)
Alternative 3 - Cost Analysis for Phosphate Stabilization; Excavation and Disposal
Present Worth Cost Estimate
Omaha Lead Site FS Report

Year	Annual Capital Costs	Annual Costs	Intermittent Costs	Total Annual Costs	Intermittent Costs Include:
1	$34,764,500	$858,750	$0	$35,623,300	
2	$34,764,500	$996,352	$0	$35,760,900	Includes monitoring of phosphate treated properties
3	$34,764,500	$858,750	$0	$35,623,300	
4	$34,764,500	$858,750	$0	$35,623,300	
5	$34,764,500	$996,352	$0	$35,760,900	Includes monitoring of phosphate treated properties
6	$34,764,500	$858,750	$0	$35,623,300	
7	$34,764,500	$858,750	$0	$35,623,300	
8	$34,764,500	$858,750	$0	$35,623,300	
9	$34,764,500	$858,750	$0	$35,623,300	
10	$34,764,500	$996,352	$0	$35,760,900	Includes monitoring of phosphate treated properties
11			$0	$0	
12			$0	$0	
13			$0	$0	
14			$0	$0	
15		$137,602	$0	$137,600	Includes monitoring of phosphate treated properties
16			$0	$0	
17			$0	$0	
18			$0	$0	
19			$0	$0	
20		$137,602	$0	$137,600	Includes monitoring of phosphate treated properties
21			$0	$0	
22			$0	$0	
23			$0	$0	
24			$0	$0	
25			$0	$0	
26			$0	$0	
27			$0	$0	
28			$0	$0	
29			$0	$0	
30			$0	$0	
Total Annual Costs				$356,921,000	
Present Worth of Annual Costs				$250,577,000	

7.0 Comparative Analysis of Alternatives

A comparative analysis of alternatives using each of the nine evaluation criteria, as required by federal regulation, is presented in this section. The purpose of this analysis is to identify the advantages and disadvantages of each alternative relative to the other alternatives. A separate comparison of the alternatives is presented under the heading of each criterion.

7.1 Protection of Human Health and the Environment

Protection of human health and the environment is addressed to varying degrees by the three action alternatives. The No Action Alternative would have no effect on the site. Therefore, it does not address any of the identified risks to human health.

Alternative 2 – Excavation and Disposal, and Alternative 3 - Phosphate Stabilization; Excavation and Treatment, both provide protection of human health through reducing exposure to lead in contaminated soils. Alternative 3 provides protection through *in situ* treatment for soils with lead concentrations between 400 ppm and 500 ppm by immobilizing lead and reducing its bioavailability. This determination was supported by OLS Bench Scale Treatability Study. The final decision to proceed with phosphate stabilization of properties will be made by the EPA after assessing public comment on the Final FS Report.

Alternatives 2 and 3 provide protection through excavation and soil replacement by removing the contaminated soils from the exposure pathway and replacing the contaminated soil with clean soil. Excavation and soil replacement eliminates the risk of exposure through direct contact with lead-contaminated soil. Exposure to lead in interior house dust would be reduced by providing HEPAVACs, training, and health education to residents at eligible properties. Providing an information registry would provide further, ongoing risk reduction for Alternatives 2 and 3.

Alternative 2 provides permanence through complete removal and containment of contaminated soils at or above 400 ppm lead concentrations. Alternative 3 provides permanence through a combination of excavation and soil replacement and immobilization of lead in phosphate-treated contaminated soils. Permanence would be provided only if the phosphate stabilization remains effective on a long-term basis.

7.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Alternative 2 complies with identified federal and Nebraska ARARs and To Be Considered Criteria. Alternative 3 would comply with the To Be Considered criteria if the phosphate treatment were effective in reducing the bioavailability of lead, and would likely comply with identified federal and Nebraska ARARs. Alternative 3 would not comply with Title 117, Chapter 4 of the NDEQ regulations if leachable phosphorous increases over time and phosphorous leaches to surface waters and contributes to algal blooms.

The No Action Alternative does not comply with the To Be Considered criteria and has no ARARs with which to comply. The detailed evaluations of Alternatives 2 and 3 for achieving ARARs and To Be Considered criteria are discussed in Section 6. The identification of potential federal and state chemical- and location-specific ARARs is discussed in Section 2.

7.3 Long-Term Effectiveness

Alternative 3 reduces risks through a combination of treatment and excavation, while Alternative 2 achieves risk reduction through excavation only. Both Alternatives 2 and 3 reduce risks for homes with soil lead levels at or above 400 ppm by using effective engineering controls. Previous studies are inconclusive as to whether phosphate treatment results in long-term reduction in the bioavailability of lead in soils. Treatment of residential soils using a phosphate amendment has not been implemented during a full scale remediation project.

Alternatives 2 and 3 also utilize an information registry and public education to further control residual risks. The No Action alternative provides no effectiveness for the protection of public health and the environment over the long term.

7.4 Short-Term Effectiveness

Alternative 2 has short-term risks for the public, environment, and construction workers from excavation and transportation efforts. Disturbed contaminated soil could enter the ambient air during excavation and transportation. However, dust suppression would be implemented for the protection of the community and workers during the remedial action. The alternative would be lengthy to implement for all affected residences, requiring several years to complete. However, the length of time at any one residence during excavation would be minimal.

Alternative 3 has the same risks as Alternative 2 in addition to exposing workers, residents, and animals to phosphoric acid and lime. Depending on the method of applying the phosphoric acid, there would be a risk to workers and property from aerosol spray. Workers would be required to wear protective clothing, including respiratory protection, during the application of the phosphoric acid. Workers would also be exposed to phosphoric acid during transfer of phosphoric acid from bulk storage facilities to the transport trucks. In addition, there would be increased risks to residents from transporting bulk phosphoric acid through residential neighborhoods.

7.5 Reduction of Toxicity, Mobility or Volume

The No Action Alternative would not reduce toxicity, mobility or volume of site contaminants. Alternative 2 would significantly reduce contaminant mobility for residences with soils having lead concentrations greater than 400 ppm through soil excavation and replacement. Alternative 3 would reduce toxicity and mobility of contaminants through phosphate treatment of soils with lead concentrations between 400 ppm and 500 ppm lead, and through the removal and replacement of excavated soils. The volume of contaminants would not be reduced.

Mobility of excavated materials placed in a soil repository or landfill is greatly reduced due to the engineering features designed to contain the contaminated soils.

7.6 Implementability

Alternative 2 and the soil excavation and disposal portion of Alternative 3 are readily implementable from an engineering perspective. Excavation methods, backfilling, and revegetation are typical engineering controls. The experience of previous actions taken at the OLS by the EPA has shown that this alternative is readily implementable.

The phosphate treatment portion of Alternative 3 would be more difficult to implement. The application of the phosphoric acid treatment on residential properties has not been attempted on a large scale. This treatment alternative can cause skin irritation as well as damage to the respiratory system of workers if not handled properly. Phosphoric acid is viscous, making application difficult and it may crystallize in winter.

The phosphoric acid could damage the exterior of a home or personal property around the home if the acid is not carefully applied. The property would have to be fenced prior to the application of the phosphoric acid to restrict access to treated areas during treatment of the property. The fence would have to remain in place until the lime was applied. Small animals and birds would still have access to the property and contact with the soil prior to the application of the lime could pose a risk to them.

7.7 Cost

The present worth cost for Alternative 2 is estimated at $165.3 million. The present worth cost for Alternative 3 is estimated at $250.6 million. No costs are associated with Alternative 1, No Action. The costs of the alternatives are listed in Tables 6-3 and 6-4.

7.8 State Acceptance

State acceptance on the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this Final FS.

7.9 Community Acceptance

Community acceptance of the alternatives will be evaluated after the public comment period closes for the Proposed Plan and this Final FS.

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Appendix A
Phosphate Treatment Cost Evaluation

Appendix B

Bench Scale Treatability Study

Omaha Lead Site

Appendix C
Preliminary Remediation Goals for Protection of Children
from Lead in Soil at the Omaha Lead Site

Appendix D

Preliminary Remediation Goals for Protection of Excavation Workers from Lead in Sub-Surface Soil at the Omaha Lead Site