RECORD OF DECISION

MADISON-WIDE RESIDENTIAL
OPERABLE UNIT 03

MADISON COUNTY MINES SUPERFUND SITE
MADISON COUNTY, MISSOURI

Prepared by:

U. S. Environmental Protection Agency
Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219

SEPTEMBER 2014

Approved by:

Robert W. Jackson, Acting Director
Superfund Division

9-26-14
Date

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ATTACHMENTS

RECORD OF DECISION

DECLARATION

SITE NAME AND LOCATION

Madison County Mines Superfund Site
OU3-Madison-Wide Residential
Madison County, Missouri
CERCLIS ID #: MOD098633415

STATEMENT OF BASIS AND PURPOSE

This decision document for OU3 Madison-Wide Residential (OU3) presents the selected remedial action for residential properties at the Madison County Mines Site (Site). This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, 42 U.S.C. §§ 9601 - 9675, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record (AR) for OU3. The AR is located at the following information repositories:

Ozark Regional Library
Fredericktown Branch
115 South Main Street
Fredericktown, Missouri 63645

U.S. Environmental Protection Agency
Region 7 Records Center
11201 Renner Boulevard
Lenexa, Kansas 66219

The Director, Division of Environmental Quality, Missouri Department of Natural Resources, concurs with the Selected Remedy as presented in the Proposed Plan. This concurrence will be included in the AR.

ASSESSMENT OF THE SITE

The Selected Remedy presented in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The assessment of the Site reveals the presence of heavy metals, primarily lead, in mine waste associated with wastes derived from historical lead mining and processing.

DESCRIPTION OF THE SELECTED REMEDY

The U.S. Environmental Protection Agency (EPA) believes the Selected Remedy for OU3-Madison-Wide Residential, Alternative 2 – Excavation, Disposal, Vegetative Cover, Potable Water Corrective Action, Health Education and Institutional Controls, with an estimated present worth cost of $8.5 million, appropriately addresses the current and potential risks to human health and the environment for this subsite. The remedy addresses human health risks through remediation of residential properties which includes residence yards, public use areas, child high-use areas, associated right of ways, roadways and storm water drainages, to below 400 parts per million (ppm) lead. The Selected Remedy also addresses corrective action for potable water at private wells through the reduction or elimination of contamination resulting from the presence of mine waste to within safe drinking water standards, in addition to providing for health education and institutional controls components.

OU3 is addressed by this final ROD which is a continuation of the response actions under the 2008 Interim ROD (IROD) under which remedial action was implemented in 2009. In addition to OU3, the Site also includes six other OUs: 1, 2, 4, 5, 6 and 7. RODs were declared and signed for both OU4 Conrad Tailings in September 2011, and OU5 Catherine and Skaggs Tailings in September 2012. Both are pending remedial action. It is expected that the remaining OUs will be addressed by future RODs for remedial action.

The major components of the Selected Remedy for OU3 Madison-Wide Residential include the following actions:

- Excavate and dispose of lead contaminated surface soil of 400 ppm and above at residential properties, and backfill and restore the properties to their original condition.

- Filtering, treatment, well repair/replacement, provision of an alternate water supply or any combination thereof at private wells to reduce concentrations of chemicals of concern (COCs) to within safe drinking water standards in potable water affected by contamination from mine waste.

- Health education for all stakeholders at the Site to inform about the risks and ways to prevent human exposure to contamination.

- Institutional controls managed at a local level in the form of a Voluntary Institutional Control Program (VICP) to monitor disturbance activities from construction and development, protect clean soil and demarcation barriers, and ensure proper handling and disposal of lead contamination should disturbance occur.

- Operation and maintenance (O&M) to ensure the VICP continues to provide the necessary protection to the remedy.

- Five-year reviews to evaluate the remedy to ensure it remains protective.

STATUTORY DETERMINATIONS

Under CERCLA § 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element as well as a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary of this ROD:

- Chemicals of concern and their respective concentrations.

- Baseline risk represented by the chemicals of concern.
- Cleanup levels established for chemicals of concern and the basis for these levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions.
- Potential land use that will be available at the Site as a result of the Selected Remedy.
- Estimated capital; annual operation and maintenance; and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factors that led to selecting the remedy.

Additional information can be found in the AR for OU3.

Robert W. Jackson, Acting Director
Superfund Division

9-26-14
Date

Record of Decision – Decision Summary

Madison-Wide Residential – Operable Unit 3
Madison County Mines Superfund Site
Madison County, Missouri

SITE NAME, LOCATION AND DESCRIPTION

This ROD, the final ROD for the Madison County Mines Site, Operable Unit 3 - Madison-Wide Residential, concerns upcoming remedial actions to address lead surface soil contamination at residential properties across the Site. It provides background information, summarizes recent information driving the Selected Remedy, identifies the Selected Remedy for cleanup and its rationale, and summarizes public review and comment on the Selected Remedy.

This ROD is a document that the EPA, as lead agency for the Site, is required to issue to fulfill the statutory and regulatory requirements found, respectively, in Section 117(a) of CERCLA, 42 U.S.C. § 9617, and in the NCP, 40 C.F.R. § 300.430(f)(4). The support agency is the Missouri Department of Natural Resources (MDNR). The EPA plans to conduct the remedial action utilizing funding sources that include special account and the Superfund Trust Fund.

The Site covers Madison County in its entirety and the Mine LaMotte Domain tract in southern St. Francois County, Missouri. As a former mining site, it includes any media impacted by heavy metals related to historical mining and processing activities and offsetting depositional impacts. The Site is located approximately 80 miles south of St. Louis in southeastern Missouri at the southern end of the Old Lead Belt where heavy metal mining began in the early 1700s and industrial mining since the 1800s (Figure 1). It consists of all areas that have been impacted by past mining practices, human distribution and migration of the resulting mine waste. The Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) identification number is MOD098633415. A citizen can use the CERCLIS number on the EPA's website to get information on the Site. CERCLIS is being replaced by a new tracking system called "Primavera". A glossary of common Superfund terms is included at the end of this document.

This ROD highlights key information from the Remedial Investigation (RI), Baseline Human Health Risk Assessment (BHHRA), Focused Feasibility Study (FS), and Proposed Plan recently released for OU3. These and other documents are available for additional information regarding the upcoming remedial action in the AR located at the addresses listed below:

Ozark Regional Library
Fredericktown Branch
115 South Main Street
Fredericktown, Missouri 63645

Hours: M, W, T, F: 10:00 a.m. – 5:30 p.m.
Tuesday: 10:00 a.m. – 8:00 p.m.
Saturday: 10:00 a.m. – 3:00 p.m.

U.S. Environmental Protection Agency
Region 7 Records Center
11201 Renner Boulevard
Lenexa, Kansas 66219

Hours: Monday – Friday: 8:00 a.m. – 5:00 p.m.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Activities leading to current problems: Lead ore was discovered in the area of Mine La Motte (north of Fredericktown) by French explorers around 1715. The area was already known to and likely was being exploited by local Native Americans. Mining commenced in the early 1720s and continued intermittently on a comparatively small scale through the 18th century. Mining and beneficiation activities increased significantly at Mine La Motte and what is now known as the Madison Mine beginning in the mid-1840s and expanded throughout Madison County in the period following the Civil War. Most of the smaller mines located around the county were operated at that time. Mining in Madison County has produced copper, lead, cobalt, nickel, iron and small amounts of zinc, silver and tungsten.

Past mining operations have left at least 13 identified major areas of mine waste in the form of tailings and chat deposits from significant mineral processing operations and smelting in Madison County (Figure 2). Chat deposits include sand- to gravel-sized material resulting from the crushing, grinding, and dry separation of the ore material. Tailings deposits include sand- and silt-sized material resulting from the wet washing or flotation separation of the ore material. The mine waste contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These deposits have contaminated soil, sediments, surface water and groundwater. These materials have also been transported by wind and water erosion or manually relocated to other areas throughout the county. Mine waste and soils contaminated as a result of mine waste erosion were used on residential properties for fill material and private driveways, used as aggregate for road construction and placed on public roads around Fredericktown to control snow and ice in the winter.

Federal, state and local site investigations; removal and remedial actions: Starting in 1980, a number of investigations by various organizations were conducted on the county's mine waste and its effects, most of which focused on the areas affected by mine waste within OU2 (Anschutz). To investigate a broader area, the EPA performed an Expanded Site Inspection (ESI) on the Little St. Francis River (LSFR) watershed at the Site in 1995. The ESI attempted to identify potential sources of mine waste in the LSFR watershed, determine the composition of these sources and determine if there had been a release of mining-related contaminants (heavy metals) to media within the LSFR watershed. Geographically, the ESI included OU1 (Northern Madison County Unit), OU2 (Anschutz) and the Catherine Mines, Skaggs Tailings and Conrad mine waste areas designated at that time as OU3. A limited number of samples were collected from mine waste, groundwater, sediment and soil, and were analyzed for heavy metals. The results indicated elevated concentrations of a number of heavy metals. Additionally, studies conducted by the Missouri Department of Health and Senior Services (MDHSS) and the Madison County Health Department (MCHD) concluded that some children in Madison County had elevated levels of lead in their blood.

As a result of the elevated blood lead levels in children, the presence of mine waste piles in Madison County and previous investigations, the EPA began conducting removal assessment activities at the Site, focusing on lead-contaminated surface soil in residential yards and other areas frequented by children, referred to as child high-use areas. The removal assessment consisted of obtaining access to residential yards or public areas, documenting current property conditions, collecting surface soil throughout the property and analyzing the samples for metals with a portable X-Ray Fluorescence (XRF) instrument.

The assessment results in the Harmony Lake area indicated children's health was at risk due to elevated lead levels in residential surface soil. These assessment results were the basis for an Action Memorandum signed by the EPA in September 2000 outlining the rationale for implementing the first removal action. The removal action consisted of excavating soil at residential properties with elevated lead concentrations up to one foot below ground surface (bgs) and two feet bgs in garden areas, and replacing it with clean soil. Additionally, the Harmony Lake tailings pile, approximately 30 acres in size, was covered with one foot of soil to stabilize the mine waste and minimize its impact on human health and the environment.

In 2002, at the request of the MCHD, the EPA tested mine waste recently brought in to be used as fill at a farm supply company in Fredericktown. Upon confirming elevated concentrations of metals, particularly lead, in the mine waste fill at the property and upon confirming at least one child living nearby with an elevated blood lead level (greater than 10 micrograms per deciliter [μg/dL]), the EPA signed an Enforcement Action Memorandum in August 2002. A removal action was conducted by Madison County Farm Supply under a Unilateral Administrative Order. The action included removing all mine waste and contaminated soil with lead concentrations greater than 400 ppm from the Farm Supply property and transporting the mine waste back to its original location, currently called the LSFR subsite.

The EPA executed another Action Memorandum in September 2002 to minimize human exposure to lead-contaminated soil in sensitive populations at child high-use areas such as daycare centers, public parks, other public recreational facilities and homes with potential lead-impacted children in Fredericktown and northern Madison County. Beginning in March 2003, removal actions were again conducted similar to those performed at Harmony Lake to address the lead-contaminated soils. The Catherine Mines subsite was used as a soil repository for this removal action. When the last removal action was completed in October 2006, over 800 residential properties including daycare centers, schools, churches, mobile home parks and child high-use areas had been remediated and approximately 205,000 cubic yards of lead-contaminated soil was transported from residential properties to the repository at the Catherine Mines subsite.

As part of the removal assessment, the EPA also collected and analyzed a limited number of surface water and sediment samples across the Site. Results of this sampling, in addition to the ongoing residential property surface soil sampling, confirmed lead and various other heavy metals at concentrations in excess of their respective background concentrations. Surface water was also sampled revealing concentrations of iron, lead, nickel, aluminum, copper and silver exceeding the MDNR's aquatic life standards. As a result of the human impact and the presence of elevated levels of heavy metals, the Site, which currently includes seven OUs, was placed on the National Priorities List (NPL) on September 29, 2003.

The Madison County Mines Remedial Investigation (RI) Report that included OU3, Residential Soils; OU4, Conrad Tailings; and OU5, CM&STS, was issued on April 2008. An IROD for OU3 was issued in July 2008, and remedial action for continuing the cleanup of residential properties including child high-use areas was implemented in October 2008. Residential soils are being transported to the Conrad tailings pile for use as a soils repository and, to date, over 400,000 cubic yards of soil and mine waste have been removed and transported as a result of the OU3 remedial actions. The combined removal and remedial actions to date have resulted in over 4,000 residential properties sampled for metals and over 1,600 residential properties remediated.

The Focused FS report for OU4 was completed in 2011, and a ROD was completed in September 2011. The remedial action for OU4 is pending. The FS for OU5 was completed in June 2012, and a ROD was completed in September 2012.

COMMUNITY PARTICIPATION

Since 1999, the Madison County Environmental Roundtable has been meeting bimonthly, and more recently quarterly, to discuss the health and environmental concerns related to the Site. These meetings have included representatives from the EPA, MDNR, MDHSS, MCHD, the Agency for Toxic Substances and Disease Registry (ATSDR), elected officials of Fredericktown and Madison County, news media, visiting academia, students and local citizens. A health education program involving all stakeholders provides proactive forums to educate the community on health issues including prevention of lead exposure, safe handling practices, in-home lead assessments and child blood lead testing.

The public was encouraged to participate in the Proposed Plan process in development of this ROD. The Proposed Plan highlighted key information from the RI Report, FS Report, BHHRA, and other supporting documents in the AR. Additionally, the public has been made aware of the environmental issues in the county through fact sheets, public availability sessions and press releases during the previous removal and remedial cleanups that have occurred and continue at the Site. To provide the community with an opportunity to submit written or oral comments on the Proposed Plan for OU3, the EPA established a 30-day public comment period from July 17 to August 17, 2014. The notice of the public comment period and availability of the AR file was published in the Democrat News on July 10, 2014.

A public meeting was held on July 17, 2014, at 6:30 p.m. at the Mineral Area College, Fredericktown Outreach Facility in Fredericktown, Missouri, to present the Proposed Plan, accept written and oral comments and answer any questions concerning the proposed cleanup. The EPA also used the public meeting for OU3 to provide an update on the ongoing residential cleanup and other details concerning provisions of the Proposed Plan. A total of 12 people were in attendance including a local resident and local, state and federal government officials. A transcript of the public meeting has been included in the AR. One comment was presented at the public meeting by a city official in response to historical information and the results of recent sampling conducted at Fredericktown City Lake, but no questions were presented or answered. The only comments received were included in the MDNR's letter of general concurrence to the Selected Remedy presented in the Proposed Plan which warranted no response. The letter (Attachment 1) is included as part of the Responsiveness Summary.

SCOPE AND ROLE OF THE RESPONSE ACTION

The EPA's overall strategy is to address the highest risks to human health first, which includes the removal of lead-contaminated soil at residential properties that exceeds 400 ppm, and transport it to repositories within Madison County already containing mine and mill wastes. Residential properties are defined as residential yards, public use areas, child high-use areas, and associated unimproved roadways/alleys, right of ways and storm water drainages. Contaminated soil is removed to achieve soil concentrations less than 400 ppm lead to a minimum depth of 12 inches below current grade, replaced with clean backfill and topsoil, and vegetated. A demarcation barrier is placed at a minimum 12 inch depth below the existing ground surface if contamination below 1200 ppm cannot be achieved within 24 inches below current grade to serve as a visual warning to residents of the presence of residual contamination. The response actions also include corrective action on potable water from private wells affected by lead and other metals within the halo of mine waste deposits and drainages to reduce or eliminate COCs to within safe drinking water standards. Institutional controls to include health education and institutional controls including the VICP will be fully implemented to educate the community and prevent the spread of and exposure to lead contamination. See the Site's History and Enforcement Activities for a description of prior response actions.

The Selected Remedy for this final ROD presents the EPA's approach to address the remedial actions for OU3. The Site has been divided into seven OUs (see Figure 2) to organize the work into logical elements based on similar contaminated media, geographic and demographic features of the Site, and for setting priorities for the work. The seven OUs are described as follows:

- OU1 – Northern Madison County Unit (OU1) is located in northern Madison County and consists of the Mine La Motte Recreation Association (MLMRA) subsite that contains approximately 250 acres of tailings; Slime Pond, a 100-acre lake used by the MLMRA; the Harmony Lake and Harmony Lake tailings; Basler Mines (also known as Copper Mines and Shoemaker Property); the Old Jack Mine; the Lindsey Mine; the Offset Mine; City of Fredericktown Lake; the small gage feeder rail right-of-way to the abandoned Black Mountain spur and abandoned Missouri Pacific right-of-way. All other areas and media affected by these former mining locations are included. Residential properties in the Harmony Lake area were included in the removal action, and the tailings were covered with residential soil and topsoil.

- OU2 - Anschutz Subsite (OU2) consists of all mining and mine works locations and adjoining areas located immediately southeast of Fredericktown. Included are the A, B, C, D and E tailings areas (historically known as the Madison Mine); a metallurgical pond and sediment pond; remnants of an old mill and smelter and associated slag pile; head frame and abandoned shafts; a mine decline; a refinery complex; a remnant chat pile and mine dump; associated groundwater; surface water and sediments in Goose Creek and Tollar Branch Creek; the abandoned Black Mountain spur right-of-way through Fredericktown; and all other mine works locations and outflows affected by these past mining activities. The current owner and a past owner are under a court order to clean up this subsite.

- OU3 – Madison-Wide Residential (OU3) includes residential yards, public areas, child high-use areas, roadways, right-of-ways, storm water drainages and potable groundwater at private wells in halos of mine waste, mine workings and outfalls. Details of the response actions and progress are stated in the Site History and Enforcement Activities Section above.

- OU4 - Conrad (OU4) includes a tailings pile and the adjoining Ruth mine and mill complex with its mine waste, surface water and sediments affected by the mine waste; eroded materials in the unnamed tributary to Mill Creek with its floodplain and overbank deposits; adjacent road right-of-ways and drainages, and mine waste pile wind-blown contamination; groundwater impacts within the mine waste locations; and all other associated mine works locations and outflows.

- OU5 - Catherine Mines/Skaggs Piles (OU5) includes the Catherine Mine with its mine waste, pond, repository, Logtown Branch Creek and associated drainages. The Skaggs tailings location includes its mine waste and associated drainages with surface water, sediment, overbank and floodplain deposits along two unnamed tributaries. Also included is the transect of a former overhead tram which transported parent rock from the Skaggs subsite to the LSFR subsite for processing; the LSFR subsite; and all other associated mine works locations and outflows. A remedial design (RD) is scheduled for completion by end of September, 2014.

- OU6 - Silver Mines (OU6) includes all other known and undiscovered mining-related contaminated areas, including but not limited to the Silver Mines area with the Einstein and Apex mines; nearby groundwater, surface waters and sediments in the unnamed runoffs to the LSFR; road right-of-way; public drainage ways; and mine works locations and outflows.

- OU7 – LSFR Watershed (OU7) includes all surface water, floodplain and overbank deposits and sediments in the LSFR watershed that are not specifically addressed under other OUs.

Changes in the OUs have been made based on findings associating locations of contamination with their respective source locations. This includes transferring the LSFR Tailings component of OU3 to OU5. This mine waste deposit is a result of processing materials transported from OU5 via an overhead tram system to a mill located on the west side of the LSFR. Additionally, the mine workings, outflows, sediment and surface water in Tollar Branch and Goose Creek, and groundwater contamination associated with these tailings and mine caverns formerly included under OU3, are to be included with OU2 which is the primary source of contamination for these components.

The Selected Remedy presented in this ROD is the final action for residential properties at the Site under OU3 and is a continuation of the removal and remedial actions. The Selected Remedies for OU4 and OU5 under their respective RODs, completed in September 2011 and September 2012, address mine waste tailings and chat; associated downstream impacts to surface water, sediment, floodplain soils and overbank deposits; surface water in named and unnamed tributaries; surface soils along roadways; groundwater within the tailings; and institutional controls in the form of environmental covenants with property owners under the Missouri Environmental Covenants Act (MoECA), Mo. Ann. Stat. 260.1000 - .1039. In general, mine waste identified at these locations will be consolidated and capped, surface water and groundwater will be monitored, and stream sediment will either be removed and consolidated or monitored for Monitored Natural Recovery.

A combined OU Supplemental RI/FS was initiated in 2011 for OUs 1, 2, 3, 5 and 6, and completion remains pending for OUs 1, 2 and 6. The response actions for OU6 will include the involvement of the U.S. Forest Service since a large geographic portion of this subsite is located on National Forest Service property. OU7 is scheduled as the last remedial action for the Site to address human health and environmental exposures to contamination related to all stream systems that are not addressed by remedial actions under the other OUs. This will be developed and supported by a watershed master plan through community involvement and acceptance.

This ROD describes the selected approach by the EPA to address OU3-Madison-Wide Residential. Continued sampling of soil and potable water is planned during the RD and concurrent with the RA to assess the remedial needs for residential properties.

SITE CHARACTERISTICS

Conceptual Site Model: A conceptual site model (CSM) for human exposure pathways to heavy metals resulting from mine waste at the Site is included as Figure 4. It should be noted that although the CSM covers all anticipated exposure at the Site, this ROD is focused on addressing OU3 residential properties and groundwater for potable use impacted by activities associated with former mining and processing wastes.

Size of Site/Geographical and Topographical Information: The Site covers all of Madison County, and the Mine LaMotte Domain tract in southern St. Francois County, Missouri (as depicted in Figures 1 and 2), which is approximately 498 square miles. OU3 covers all residences within the Site boundaries, including the City of Fredericktown, all smaller towns, villages and communities (both incorporated and unincorporated), and rural locations. The geographic center of the Site is located approximately 80 miles south of St. Louis along U.S. Highway 67 and is situated in and around the Mark Twain National Forest. The Site also has 13 major tailings locations where mining and processing wastes have been deposited as a result of historic mining. It is estimated that 5,300 residential properties are subject to the response actions. Properties remaining to be sampled and determined eligible for remediation are presented in Figure 3. Approximately 2,000 private wells exist throughout the Site, and it is estimated that as many as 60 of these wells are within the halos subject to the response actions.

Surface and Subsurface Features: Madison County is subdivided into the St. Francois Mountains on the western side and the Salem Plateau on the eastern side of the county. Topographically, the St. Francois Mountains comprise a geologically mature landscape with rounded ridges and meandering streams that occupy comparatively wide valleys. In a few locations, rivers and streams cut across ridges, forming steep canyons.

Much of the Site is underlain by Paleozoic (Cambrian) sedimentary rocks that rest on Precambrian crystalline rocks or basement complex which form the St. Francois Mountains. The sedimentary formations vary in thickness and locally thin out or pinch out against structural highs of the basement complex (St. Francois Mountains). The rock formations present in the area include the following from the Precambrian basement: (1) the Lamotte Sandstone, (2) the Bonneterre Dolomite, (3) the Davis Formation, and (4) the Derby-Doe Run Dolomite. Soil formed from these formations is predominantly clay with comparatively low permeability. Soil profiles and horizons are generally well developed.

Most lead mineralization in the Madison County area occurs within the lower part of the Bonneterre Dolomite on the flanks of buried or exposed Precambrian topographic highs, generally within a few hundred feet of the boundary where the underlying Lamotte Sandstone pinches out. Lead ore, primarily in the mineral galena, and other metallic minerals occur as deposits that have replaced dolomite crystals in portions of the Bonneterre Dolomite. The ore occurs in horizontal sheets along bedding planes, cavity fillings and linings on the walls of joints and fractures. The deposits extend laterally for hundreds of feet and may extend 200 feet vertically. However, mineralization in the Silver Mines area is distinct, correconsisting of quartz veins in the Precambrian basement complex that contain galena, wolframite (iron tungstate) and additional sulfide minerals as primary ore phases for additional metals such as tungsten and silver.

Groundwater is described as occurring both within unconsolidated overburden soils and bedrock. Groundwater within the overburden materials is less abundant than in the bedrock due to the generally low permeability and thin character of the local soils. Two main aquifers are identified in the area: the Bonneterre Transition Zone and the Davis Formation/Whetstone Creek member. These two aquifers are separated by the Lower Bonneterre Formation which serves as an aquitard or confining bed that impedes the exchange of water between the two aquifers.

The Bonneterre Transition Zone is mudstone that grades downward into dolomitic sand. The sand has an estimated hydraulic conductivity on the order of 3.1 feet per day. The Whetstone Creek Member is a medium- to coarse-grained crystalline dolomite with interbedded gray and green shales. This unit is locally a major source of groundwater and is considered to be a more significant water-bearing unit in the area due to its higher hydraulic conductivity, estimated at 11 feet per day. Groundwater flow within the region is poorly defined, but under natural or undisturbed conditions is projected to follow the overall topographic gradients. Flow within both unconsolidated overburden and bedrock is expected to be from upland areas to lower topographic areas such as along the major drainage courses. Mine workings, including open and collapsed stopes, tunnels and rooms, are expected to locally alter groundwater flow. Rates of groundwater flow are unknown but expected to be potentially high based on the aggregate pumping required to dewater the Madison Mine workings, being on the order of 1,000 to 1,500 gallons per minute. Consequently, most of the lead mines within the Bonneterre Formation are expected to be at least partly flooded. Mine workings associated with the Silver Mines area are also expected to be partly flooded based on observations of drainage emanating from some mine adits.

Groundwater at the Site is predominantly alkaline in nature, attributed mostly to the presence of sedimentary dolomite and limestone. Alkaline groundwater buffers the dissolution of metals and has been attributed as a major reason for the lack of dissolved metals in groundwater outside the former mining and processing locations at the Site where limited detection has been observed. There are an estimated 2,000 private wells at the Site potentially used for consumption or potable water. These include both shallow wells in the unconsolidated overlying soils and deeper wells penetrating the Cambrian sedimentary rock, the Precambrian basement formations, or both.

Sampling Strategy: Surface soil sampling of residential properties is performed similar to the approach taken during previous removal and remedial actions, and remains ongoing. Currently, soil sampling and metals analyses of over 4,200 residential properties across the Site have been performed. The sampling generally involves dividing a residential property into four quadrants and compositing nine aliquots of surface soil from each quadrant. Typically, separate multi-aliquot samples were collected from gardens, child play areas, and non-paved driveways. Samples were analyzed using an XRF instrument with 10 percent of the samples collected submitted for laboratory confirmation analysis.

Potable water samples were collected from 45 homes using private wells as their primary drinking water. The samples were analyzed for heavy metals in a laboratory (see Table 4). Prior to collection, water was allowed to flow from the tap for at least two to three minutes to purge the water pipe. Three samples exceeded the lead Maximum Contaminant Level (MCL) of 0.015 ppm, but upon being resampled all tested below the MCL. The water samples were used for calculating human health risks for groundwater as detailed in the HHRA described in the next section. In addition to the EPA's sampling of potable water from residences with private wells, the MCHD has sampled around 410 private wells since early 2000. Although the MCHD sampling data was not used for the purpose of calculating human health risk or for decision-making purposes for this ROD, nine of the 410 wells sampled exceeded the lead MCL of 0.015 ppm. For observation purposes only, the MCHD data suggests that as many as 2 percent of all private wells could possess elevated lead in groundwater.

Samples were also collected from roadways, storm water drainages and right of ways during the RI. These results confirmed that over 80 percent of the samples collected at these locations revealed concentrations of lead in excess of 400 ppm (see Table 5).

In the HHRA, as summarized in the next section, lead was identified as the primary COC, although other metals were infrequently identified in various media and locations as COCs in select situations. The final ROD focuses on lead since it is generally the primary COC in a residential property setting in this lead mining area and is co-located with other identified metals of concern. Lead is a metal and a constituent of D008 hazardous waste. It is classified by the EPA as a probable human carcinogen and is a cumulative toxicant. The organic form of lead is generally unstable and undergoes rapid conversion to inorganic lead compounds. Most forms of inorganic lead are relatively insoluble, tend to bind tightly to soil, and are relatively immobile.

Continued sampling of surface soil will be performed during the RD/RA phase to complete the characterization of all residential properties. Potable water from private wells will be sampled, and its location and well components (such as casing and grout seal at the top of the casing) evaluated if suspected to be located within the halo of mine waste locations, workings and outflows. Sampling may also be conducted to confirm sample results from private wells sampled by the MCHD. Sampling is subject to property owner access consent and has presented many challenges in terms of their acceptance of the response actions conducted by the EPA.

Type of Contamination and Affected Media and Sources of Contamination: Contamination at the Site includes mostly heavy metals in soil, sediment, surface water and groundwater resulting from past mining and processing.

Quantity and Volume of Waste: The estimated quantity of soil waste remaining to be addressed under this ROD is 55,800 cubic yards for approximately 300 properties expected to exceed 400 ppm lead. This does not include the remaining estimated 52,600 cubic yards of soil for 283 properties already identified that have yet to be addressed under the IROD remedial action. These estimates are based on the historical incidence of the presence of contamination where it has been determined that around 40 percent of all residential properties tested exceed the 400 ppm cleanup level. This volume would be considered a maximum volume estimate. For groundwater, it is estimated that as many as 60 operating, private wells are located in the halo areas of mine waste, workings and outflows that could be impacted. It is projected that as many as 30 of these wells may require some form of corrective action. Since only potable water will be treated for the residence as opposed to widespread groundwater remediation, groundwater volume is not calculated.

Concentrations of Chemicals of Concern (COCs): Table 1 presents a list of Site Chemicals of Potential Concern (COPCs) that includes the COCs for this ROD. For soil, lead is identified as the primary COC with the presence of other metals including aluminum, arsenic, iron and manganese collocated with lead at residential properties. Lead concentrations at the Site range from below average background concentrations of 140 ppm to over 20,000 ppm. Groundwater used for potable water from private wells also includes lead with its highest concentration detected at 274 micrograms per liter, or parts per billion (ppb). Other groundwater COCs and their respective maximum concentrations include aluminum (335 ppb), arsenic (39.8 ppb), chromium (28.8 ppb), fluorine (6.3 ppb), iron (34,500 ppb), and manganese (499 ppb).

RCRA Hazardous Wastes: Lead and arsenic are D-listed hazardous waste constituents pursuant to the Resource and Conservation Recovery Act (RCRA) as set forth in 40 C.F.R. § 261.24. Both are classified by the EPA as probable human carcinogens and are cumulative toxicants. In 1980, RCRA was amended by adding section 3001(b)(3)(A)(ii), known as the Bevill Exclusion, to exclude "solid waste from the extraction, beneficiation, and processing of ores and mineral" from regulation as hazardous waste under Subtitle C of RCRA. This exclusion was intended to exclude from RCRA low toxicity, high volume waste which led to the exclusion of 20 mineral processing wastes at 40 C.F.R. § 261.4(b)(7), including slag from primary lead processing.

Location of Contamination and Known or Potential Routes of Migration: While sampling is ongoing, it is projected that as many as 300 residential properties will possess lead contamination in excess of 400 ppm in addition to the 287 known residential properties. Mine waste chat and tailings remain in 13 major locations throughout Madison County, and residential properties affected from mine waste transport through wind erosion, water erosion and human transport are also present in the Mine LaMotte Domain Tract in southern St. Francois County.

Current and Potential Routes for Human and Environmental Exposure: Ingestion of metal-contaminated soil and water is the primary route of exposure to COCs by humans. Inhalation of metal-contaminated dust from the waste piles and surface soil is also identified as an exposure route for humans but constitutes a lower risk based on site specific characteristics, land use and human activity. The conceptual site model in Figure 4 shows exposure pathways and receptors. Additional detail concerning exposure pathways and receptors can be found in the Summary of Site Risks.

Lateral and Vertical Extent of Contamination: There is considerable variability in lead concentrations found in surface soil at residential properties across Madison County, both from property to property and within each individual property. The actual use and amount of mine waste used as fill on a property, as well as how well it was mixed with existing soil, would greatly affect lead soil concentrations at a residential property. Later modification of residential properties resulting from filling, grading, or other activities could either cover or dilute lead contamination at the surface. Erosion of surface soil during rain events can relocate lead-contaminated soil. High water and extensive rain events have moved mine waste from their source piles onto residential properties, increasing lead contamination at those properties. It is likely that a combination of these factors has resulted in the observed discontinuous horizontal nature of lead contamination in soil at residential properties across the county. The vertical extent of lead contamination in residential soil also varies as indicated during the previous removal actions. Humans residing at the residential properties impacted by surface soil with lead concentrations above 400 ppm are potentially exposed through routes of ingestion and dermal contact.

There is no confirmed lateral migration of groundwater contamination outside the halo areas of the major mine waste locations. The limited detection of contaminated groundwater outside mine waste area halos supports the theory that the incidence of groundwater contamination at private wells is extremely isolated and not widespread, however, the frequency will be further assessed during the RD/RA under this ROD.

Likelihood for Migration of COCs: The organic form of lead is generally unstable and undergoes rapid conversion to inorganic lead compounds. Most forms of inorganic lead are relatively insoluble, tend to bind tightly to soil, and are not highly mobile. The migration of mine waste to residential properties is associated in most cases with physical, human transport, and attributed to a very limited degree to air transport. Water erosion resulted in the deposition of contamination from source areas to the floodplains of tributaries, creeks and rivers; soil was then collected from these locations for fill and grading at residential properties. Mine waste was also transported for use on roads and driveways. Only in limited circumstances has contaminated soil at a residential property migrated to adjacent properties.

Groundwater contamination has been detected mostly at mine waste source locations. Localized groundwater contamination has not been confirmed as a result of the presence of contaminated soil or chat used on residential yards and driveways. However, there is a high likelihood that lateral migration of groundwater possessing high concentrations of dissolved COCs at mine waste halo locations could impact groundwater in their vicinity and be diverted by private wells. Additionally, direct surface runoff of solids from tailing locations could directly impact groundwater at a private well by entering the well column as a result of improper construction and grouting, or damaged and compromised well components such as casings and well heads. Surface migration of contamination would likely be limited to solids being transported by erosion, and would less frequently be in the form of groundwater leachate from the sides and base of tailings deposits.

Human and Populations that could be Affected: The populations that could be affected are discussed in the Summary of Site Risks following the next section.

CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Since mining operations have ended in Madison County, the primary land use is agricultural crop and pasture land. Industrial activities consist of light manufacturing, aggregate production, and construction. The population is predominantly rural. According to 2010 census data, the population of Madison County is 12,226, including 4,857 households and 5,929 housing units. In addition, the county has approximately 260 nonfarm businesses, 6 schools, 400 farms, 300 miles of unimproved rural roads, 100 miles of paved rural roads, 1 major river, 1 secondary river, and 1 water supply district. The city of Fredericktown draws its water supply from the City of Fredericktown Lake on the LSFR. The Madison County Public Water Supply District (PWSD) provides water to rural customers from wells located north and south of Fredericktown, and rural residents not served by the PWSD are supplied by potable water from their own private wells.

Current On-Site Land Uses: The primary land use within Madison County since mining operations ended is agricultural crop and pasture land. Industrial activities consist of light manufacturing, aggregate production, and construction.

Future Property Use: Residential and commercial development is projected to continue increasing over time based on past trends which could change future land use or land use designations of currently undeveloped properties to a limited degree.

Current Ground/Surface Water Uses: Groundwater is utilized at private and public wells for potable domestic use, irrigation and stock water. Surface water from the Fredericktown City Lake is used for public supply, recreational purposes and irrigation. Lakes and ponds are available for recreation and stock water use.

Future Ground/Surface Water Use: All current uses are likely to continue indefinitely with no foreseeable changes based on current projections.

SUMMARY OF SITE RISKS

A baseline HHRA dated July 9, 2007 (included in the AR as a RI appendix), was conducted for the Site to assess the potential risks to humans, both now and in the future, from site-related contaminants present in environmental media including surface soil, indoor dust, sediment, surface water, groundwater, and fish tissue. The toxicity and exposure assessments as well as the risk characterization for lead are intrinsically included in the Integrated Exposure Uptake Biokinetic (IEUBK) model used to evaluate potential lead effects on human health. EPA's IEUBK model predicts that a young child residing at the Site will have more than a 5 percent chance of having a blood lead concentration exceeding 10 µg/dL, if the soil lead concentrations are above 400 ppm. This section of the ROD summarizes the results of the HHRA.

The HHRA determined that lead is the most frequently identified COC in soils and is the primary risk driver for the remedial action at residential properties described in this ROD. Other metals such as aluminum, antimony, arsenic, chromium, iron, manganese, nickel, thallium, and vanadium, and on a more limited basis manganese, cadmium, selenium, arsenic, iron, zinc, and chromium, contributed to site risks. This ROD focuses on lead because it is the primary COC at the residential property portion of OU3 at the Site. Contributions of other metals in soil that coexist with lead result in increased health risks, but on a property-by-property basis, the detection of other metals appears isolated to the extent that they do not pose individual site risks.

Groundwater contamination at mine waste locations presents human health risks through ingestion. Individually, fluoride presents the highest risk at private wells. Metals including antimony, arsenic, iron, copper, lead, and manganese were detected but do not individually present human health risks of concern. However, when combined with contaminated soil, the risk for ingestion of potable groundwater at some private well locations outside of mine waste halo locations elevates the health risks to a level of concern.

Exposure pathways and exposed populations: Figure 4 presents the CSM which shows the variety of exposure pathways by which site-related COPCs may migrate from on-site mine waste piles acting as the major sources of contamination for other environmental media such as soil and indoor dust. The CSM also shows the various human populations that might reasonably be exposed to heavy metals, in particular lead, in the environment. However, not all of these potential exposure pathways are likely to be of equal concern. Additionally, with respect to residents, two potential exposure scenarios were not quantitatively addressed in the HHRA. First, exposure to heavy metals by ingestion of garden vegetables is a complete pathway but data from vegetables has not been collected. Second, exposure to heavy metals in roads and alleys was not quantified because the extent of that exposure is not known with certainty.

With respect to lead contamination, young children (typically defined as seven years of age or younger) across Madison County are the population group of primary concern potentially exposed at the Site. Young children are more susceptible to lead exposure than adults because they have higher contact rates with soil or dust, absorb lead more readily than adults, and are more sensitive to the adverse effects of lead than are older children and adults. Thus, the most important exposure pathway for children is incidental ingestion of soil and dust. The effect of greatest concern in children is impairment of the nervous system, including learning deficits, lowered intelligence, and adverse effects on behavior.

The risks or potential for adverse health effects from lead are evaluated using a different approach than for most other metals. Because lead is widespread in the environment, exposure can occur by many different pathways. Thus, lead risks are based on consideration of total exposure (all pathways) rather than just site-related exposure. Because most studies of lead exposures and the resultant health effects in humans have traditionally been described in terms of blood lead level (expressed in µg/dL), lead exposures and risks are typically assessed using mathematical models. Additionally, because lead does not have nationally-approved toxicological values which can be used to assess risk, standard risk assessment methods cannot be used to evaluate the health risks associated with lead contamination. Therefore, the HHRA used the EPA's IEUBK Model for Lead in Children to estimate the distribution of blood lead levels in a population of residential children exposed to lead at the Site. Typically, the focus of an HHRA with respect to lead in a residential setting is on children since they are at a greater risk than older children or adults. For this HHRA the Adult Lead Model was also used. By using a lead model for the population at greatest risk, namely children, adults are also protected (including pregnant women.) Thus, the IEUBK model was used to evaluate the risks posed to young children (0 to 84 months) as a result of the lead contamination at the Site.

The IEUBK model uses site-specific and default inputs (i.e., surface soil concentration, indoor dust concentration, bioavailability, etc.) to evaluate exposure from lead in surface soil, drinking water, dust, and ambient air to estimate the probability that a child's blood lead level might exceed 10 µg/dL. The EPA's health protection goal is that there should be no more than a 5 percent chance of exceeding a blood lead level of 10 µg/dL in a given child or group of similarly-exposed children. The basis for this goal is that the Centers for Disease Control and Prevention and the EPA have conducted analyses demonstrating health effects at or below a blood lead level of 10 µg/dL.

For a residential child, the IEUBK model was run for each individual residential property because most exposure for a young child will occur at their residence using available site-specific data. First, surface soil lead concentrations, represented by concentrations in soil particles less than 250 micrometers (µm) at 970 individual unremediated residential properties were included in the HHRA. Second, paired soil and indoor dust data collected from 43 unremediated residential properties were used to estimate indoor dust lead concentrations. Finally, testing was performed to estimate the relative bioavailability or the amount of lead absorbed into the body from the gastrointestinal tract following ingestion of lead-contaminated soil. The results indicated that uptake of lead at the Site is greater than the IEUBK model default value. Default inputs were used for the remaining input parameters.

<u>Risk results for residents from surface soil</u>: Risk evaluation was performed prior to the RA under the OU3 IROD. Of the 970 residential properties evaluated during the BHHRA, children residing at 171 properties (18 percent) were predicted to have a greater than 5 percent chance of exceeding a blood lead level of 10 µg/dL. Children in the remaining estimated 799 homes (82 percent) were predicted to have blood lead levels at or below the EPA's health protection goal. Table 2 incudes a summary of risks to child residents from exposure to lead in surface soil. The risk assessment results indicate that a child exposed to residential property surface soil lead concentrations above 400 ppm would have greater than a 5 percent chance of exceeding a blood lead level of 10 µg/dL. To clean up to 400 ppm, the surface soil sample should be sieved with a #10 mesh sieve to obtain particles less than 2 millimeters (i.e., the bulk soil fraction) that can be analyzed with an XRF instrument.

The BHHRA incorporated assumptions of the number of homes based on estimates current at the time of development. Approximately 880 of the original estimated 1100 residential properties under the IROD RA have been remediated, and 283 residential properties are known to exceed 400 ppm in at least one sample at the property and could require remediation. During the IROD RA, the Site was expanded to include the Mine LaMotte Domain Tract in southern St. Francois County. Based on historical Site data that approximately 40 percent of all properties sampled will exceed 400 ppm and qualify for remediation, in addition to the most recent county assessor database information with parcel information updated, it is estimated that approximately 300 residential properties are projected to qualify for remediation under the final ROD response actions.

Other metals were identified in various media and locations as COCs in select situations. The BHHRA determined that surface soil at several residential properties may present a non-cancer risk to children from a number of heavy metals, excluding lead, at the maximum sample concentration. It is important to note that if these risks were based on average heavy metal concentrations in soil, the residential property surface soil would not exceed a level of concern for children. However, at residential properties where heavy metals in surface soil present a risk to children and are co-located with lead, the EPA addresses this risk. Further details may be found in the HHRA.

Risk estimates for residents from groundwater: Exposure to concentrations of lead in groundwater does not result in predicted blood lead levels exceeding the EPA's health-based goal for current child residents at most locations, with the exception of two wells located in Fredericktown. It should be noted that subsequent resampling of these private potable wells yielded lead concentrations in the groundwater below the lead MCL. Table 2 includes a summary of risk to child residents in groundwater.

With regard to other COPCs, there does not appear to be a non-cancer risk to the majority of current child and adult residents from ingestion of groundwater alone from private water wells, although there are some risks exceeding a level of concern for current residents at a number of wells. In most cases, this risk is associated with elevated levels of fluorine with additional contributions from other COPCs. The Madison County Health Department has indicated that samples of groundwater it has collected in portions of northwestern Madison County reveal fluorine concentrations. Fluorine is likely present as a result of dissolution of fluorite which is common in igneous rock (i.e., granite) present throughout the Site and is considered naturally-occurring. Iron and manganese are also present in igneous rock in addition to sedimentary rock (i.e., dolomite, limestone, etc.) and is naturally-occurring throughout the Site where background concentrations are noted outside of mining and processing waste locations. The results support the theory that concentrations of several metals in filtered and unfiltered fractions of shallow groundwater at mine workings and tailings areas pose an unacceptable cancer and non-cancer risk if used for drinking water. Therefore, potable groundwater diverted at or near mine waste locations and in mine workings and outflows, referred to as halos, remains the major rationale for potable water to be addressed in future response actions under this final ROD.

Chemicals of Concern

The EPA identified the principal risks to human health associated with two metals, lead and arsenic, identified as the COCs for OU3. Since arsenic, along with other metals, is collocated with lead in residential property soils, the primary COC for soil is lead. Lead, aluminum, arsenic, copper, iron, manganese, zinc and vanadium are also identified as COCs for potable groundwater at the Site. Regardless of this designation, any detected COC identified during sampling of potable water attributed to former mining or processing will be addressed.

Primary Exposure Route

Ingestion of metal-contaminated soil and water is the primary route of exposure to COCs by human receptors. Inhalation is also identified as a human exposure pathway but constitutes a lower risk at OU3 based on site-specific characteristics, land use and activity.

Summary of Human Health Risk Assessment

The 2007 BHHRA risk assessment data was used to develop the preliminary remediation goals (PRGs) discussed in the Remedial Action Objectives section. The BHHRA identifies the known and potential risks to humans, both now and in the future, from site-related contaminants present in environmental media including surface soil, dust, sediment, surface water, groundwater and fish tissue. This ROD addresses residential properties, to include only soil and potable groundwater. The BHHRA assumes that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media.

Exposure Assessment

The BHHRA and supporting risk documents identify the following receptors and exposure pathways for quantitative assessments of the risks to human receptors at OU3:

- <u>Child and Adult Residents</u>: Ingestion of and direct contact with surface soils combined with hypothetical future ingestion of shallow groundwater near the mine waste.

- <u>Future Child and Adult Residents</u>: Ingestion of and direct contact with surface soils combined with hypothetical future ingestion of shallow groundwater near the mine waste.

- <u>Commercial Workers</u>: Ingestion of and direct contact with surface soils combined with hypothetical future ingestion of shallow groundwater near the mine waste.

Land and Groundwater Use Assumptions

Residents at residential properties currently use and will continue to use groundwater from private wells for domestic purposes. Shallow groundwater near the mine waste is used and could be used in the future for drinking water purposes. Residential and commercial development may occur at or near the mine waste areas. Use of mine waste as construction grading and fill material, in addition to use for spreading on roads for traction during deicing operations, could occur.

Toxicity Assessment

Assuming no response action to address COCs is performed at the OU3 Madison-Wide Residential, the risks based on toxicity characterization are as follows:

- If contaminated soil at residential properties was not remediated, children could be exposed to lead and other COCs resulting in a modeled P10 of 5 percent or greater. A P10 value of 5 percent is the EPA's health-based goal using the IEBUK model to determine and set the lead level for soil and other media to limit exposure such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated probability of no more than 5 percent of exceeding a 10 µg/dL blood lead level, considered an elevated blood lead level.

- If shallow groundwater near the mine waste areas was used for drinking water purposes in the future, children ingesting groundwater could have a non-cancer risk exceeding modeled P10 values of 5 percent.

- Future pregnant residents or construction workers who ingested soil and shallow groundwater at the mine waste locations could have blood lead levels exceeding the P10 value of 5 percent.

Human Health Risk Characterization

Exposures to lead were assessed separately from the other identified COCs through the use of the IEUBK Model for the OU3 IROD, which is part of the AR. Human exposure to lead is consistent across the Site. The risk assessment identified potential health risks for children, adults and human fetuses who live on and near mine and mill wastes and who also consume garden produce. The assessment showed an unacceptable risk for people living on soils or mine waste impacted with lead above 400 ppm and for shallow groundwater use, near the mine waste area, exceeding the federal action level for lead of 15 mg/L. Please refer to the BHHRA and supplemental documents in the AR and the Conceptual Site Model under the Site Characterization section, which includes a flow chart of the general site risks.

Uncertainties

Quantitative evaluation of the risks to human health from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentrations in the environment, the true amount of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data is available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a HHRA. In most cases, assumptions employed in the HHRA to deal with uncertainties were intentionally conservative. Thus, they are more likely to lead to an overestimate rather than an underestimate of risk.

REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives (RAOs) set the goals for the remedial action and identify the RAOs for the surface soils at residential properties, and groundwater as it relates to potable water diverted at private wells, at OU3. The following RAOs were developed in accordance with A Guide to Preparing Superfund Proposed Plans, Records of Decisions, and Other Remedy Selection Decision Documents, OSWER 9200.1-23.P, July 1999:

Soil

Based on current Site data and evaluations of potential risk, lead was identified as being the primary COC and is collocated with other metals. The primary cause of human health risk from residential property soil at the Site is through direct ingestion (by mouth). A single RAO has been established for residential property surface soil at the Site that is consistent with EPA guidance including the Superfund Lead-Contaminated Residential Sites Handbook. Thus, the RAO for the residential property soil at the Site is to:

> **Reduce the risk of exposure of young children (children under seven years of age) to lead such that an individual child or group of similarly exposed children have no greater than a 5 percent chance of exceeding a blood lead level of 10 μg/dL.**

Based on site-specific information, the EPA's IEUBK model predicts that a young child residing at the Site will have greater than a 5 percent chance of having a blood lead level exceeding 10 μg/dL if the lead soil concentrations to which he or she is exposed are above 400 ppm under the assumed exposure conditions. Thus, 400 ppm lead in soil will be the cleanup level for the remedial action as measured in the bulk soil fraction using an XRF instrument. Achieving this target concentration will eliminate exposure to humans through direct contact that can result in ingestion.

Diverted Groundwater for Potable Use from Private Wells

The incidence of groundwater contamination is highly variable across the Site and, in most cases, is not reflective of widespread contamination affecting shallow or deep aquifers resulting in contamination plumes outside of the mining and processing areas. The threat of exposure from groundwater ingestion is likely to exist in private wells located in and around the mine waste locations or halos. Corrective action for potable water diverted from private wells in halos will be developed on a residence-specific basis to:

> **Reduce or eliminate COCs resulting from mine waste in potable water diverted from private wells to meet the EPA's safe drinking water standards.**

Basis and Rationale for RAOs

Because there are no federal or state cleanup standards for lead contamination in soil, the EPA established the stated cleanup levels based on information in the BHHRA. Cleanup levels were selected (based on PRGs) that would reduce the risk associated with human exposure to soil contaminants, primarily lead, to an acceptable level.

Potable water for public consumption is regulated by the EPA under the Safe Drinking Water Act (SDWA). For the purpose of providing protection to residents with private wells impacted from mine waste, the standards used for public water are applied. The EPA has established MCLs, Secondary MCLs and Action Levels, collectively referred to as safe drinking water standards, to ensure public water supplies meet thresholds considered protective of human health. Although private wells are not regulated as such, for the purpose of human health protection, standards used for public water supplies are applied for this ROD which are considered protective to human health.

Cleanup Levels

Surface Soil, Unimproved Roads/Alleys, Right of Ways and Storm Water Drainages at Residential Properties:

> **Lead – 400 mg/kg**

A determination will be made through 10 percent comparative analyses during the RD/RA phase to confirm historic evidence that achieving the cleanup standard for lead in soil will accomplish meeting the cleanup levels for other COCs.

Potable Groundwater Diverted from Private Wells:

> **All COCs – MCLs under the SDWA**

DESCRIPTION OF ALTERNATIVES

Description of Remedy Components

Three alternatives were developed in the FS to meet the identified RAOs. The alternatives were developed to specifically address lead-contaminated residential surface soil. With the exception of the possibility of phosphate treatment for a portion of properties with contamination less that 800 ppm for Alternative 3, Alternatives 2 and 3 have common elements.

The EPA considered phosphate treatment for reducing the risk of exposure through contaminated soils during the preliminary screening of remedial alternatives for the FS. At that time, an extended study of phosphate treatment technology at the Oronogo-Duenweg Superfund site in Jasper County, Missouri, had achieved a maximum of 40 percent reduction in bioavailability over a seven-year study period. However, the technology had not undergone any implementability testing by the EPA at a residential property. A recent review of the technology at the Omaha Lead site entitled "Evaluation of Phosphate Treatment at Residential Properties; Omaha Lead Site, Omaha, Nebraska" (Attachment2) has indicated concern about implementability, cost effectiveness and community acceptance in a residential setting, as well as the long-term presence and monitoring of lead in the soil even if its bioavailability has been reduced.

Based on these studies and the similarity in sites, the EPA concluded that phosphate treatment of residential soils contaminated with lead would not be considered for evaluation as a remedial alternative for OU3. The description and comparative analysis of Alternative 3 in the following sections are presented since they were part of the IROD for OU3 and present additional comparison of Alternative 3 to the other alternatives.

Alternative 1: No Action

Estimated Total Capital Cost: $0
Estimated Annual O&M Cost: $0
Estimated Present Worth Cost: $0
Estimated Construction Time Frame: N/A
Estimated Time to Achieve RAOs: Indeterminate

The NCP requires that the EPA consider a no-action alternative against which other remedial alternatives can be compared. Under this alternative, no further action would be taken to monitor, control or remediate the threat of lead exposure in residential property soil at the Site. Alternative 1 would not meet the RAOs because it does not minimize or eliminate the existing or future potential exposure to lead contamination.

Alternative 2: Excavation, Disposal, Vegetative Cover, Potable Water Corrective Action, Health Education and Institutional Controls

Estimated Total Capital Cost: $10.0 million
Estimated Annual O&M Cost: $140,000
Estimated Present Worth Cost: $8.5 million
Estimated Construction Time Frame: 2 years
Estimated Time to Achieve RAOs: 4 years

Alternative 2 is summarized as follows:

- Excavation and removal of surface soil above 400 ppm lead until soil concentrations fall below 400 ppm, or a to a minimum depth of 12 inches bgs if less than 400 ppm cannot be achieved. Excavation will continue to 24 inches bgs if a soil concentration of less than 1,200 ppm can be achieved except in garden areas where less than 400 ppm must be achieved down to 24 inches bgs.
- Clean fill and topsoil replacement and revegetation.
- Disposal of excavated soil at an EPA-approved disposal facility.
- Corrective action for potable water at private wells in halos to reduce levels to within EPA safe drinking water standards.
- Health education and outreach.
- Institutional Controls (ICs).

Under this alternative, a residential property with at least one quadrant testing greater than 400 ppm lead would be remediated. If the remaining drip zone of that property exceeds 400 ppm lead, the drip zone would also be remediated. A residential property with no quadrant exceeding 400 ppm lead would not be remediated under this action. Based on the current status of past removal and remedial actions, this action would include sampling an estimated 750 remaining properties and, based on historical averages, result in remediating an estimated 300 properties. It also includes backfilling remediated properties with clean backfill and topsoil (defined as less than 100 ppm lead and meeting other metals screening values for use), and revegetating.

The Conrad Repository would initially be used for the disposal of excavated soils, and later disposed of at a new repository currently being considered for development. The new repository would serve as a convenient and economical location for the public within the Site boundaries to dispose of contaminated soil encountered during home construction projects, city and county improvement projects, and possibly new developments. For contaminated soil or other mine waste determined to fail TCLP, a stabilization component such as phosphate may need to be mixed with it for acceptable disposal at any approved disposal location.

Private wells in halo areas of mine waste will be sampled and evaluated to determine the source and cause of contamination. If contamination is not naturally occurring, corrective action will be pursued that could include one or a combination of the following to reduce or eliminate COCs to within safe drinking water standards: filtering, treatment, well repair, well replacement or providing an alternate water supply through connection to a public water distribution system.

Under this alternative, the established and active health education program would continue in cooperation with the EPA, ATSDR, MDNR, MDHSS and MCHD. Education would primarily be conducted by the MCHD.

For ICs, the Voluntary IC Program (VICP) has been developed during the IROD remedial activities in conjunction with concerned citizens and government stakeholders as a local program to be operated by the MCHD. The intent of this program focuses on monitoring residential properties and testing disturbed soil, preventing disturbances to soil/demarcation barriers, and ensuring that proper handling and disposal of contaminated soil is accomplished if disturbance occurs. A VICP Manual (Attachment 3) has been developed for use by all stakeholders as a guide to encountering, handling and disposing of lead contamination.

Under Alternative 2, the future land use of the remediated residential properties is not anticipated to change, and the remedy is expected to enhance land use by providing clean soil with unrestricted use at the surface to a minimum depth of 12 inches bgs. Barriers will identify contaminated soil left in place and will be protected through the VICP, which will provide the necessary monitoring for disturbance events to protect both clean soil and demarcation barriers and prevent exposure potential to contamination left in the subsurface. Private wells may continue to be used and potable water treated as necessary.

O&M would involve maintaining the remediated property clean soil and demarcation barriers, and preventing any future spread of contamination at residential properties.

Alternative 3: Phosphate Stabilization, Excavation, Disposal, Vegetative Cover, Potable Well Corrective Action, Health Education and Institutional Controls

Estimated Total Capital Cost: $13.5 million
Estimated Annual O&M Cost: $140,000
Estimated Present Worth Cost: $11.5 million
Estimated Construction Time Frame: 4 years
Estimated Time to Achieve RAOs: 4 years

Alternative 3 has the same elements as Alternative 2 with the exception of the additional use of phosphate treatment for treating contaminated soil possessing lead at 800 ppm lead or less, and includes the following elements:

- Excavation and removal of surface soil above 400 ppm lead until soil concentrations fall below 400 ppm, or a to a minimum depth of 12 inches bgs if less than 400 ppm cannot be achieved. Excavation will continue to 24 inches bgs if a soil concentration of less than 1,200 ppm can be achieved except in garden areas where less than 400 ppm must be achieved down to 24 inches bgs.
- In situ phosphate treatment for quadrants possessing soil from 400 ppm to 800 ppm lead.
- Clean fill/topsoil replacement and revegetation for the properties excavated.
- Lime added to treated areas to neutralize acidic soil condition and revegetation.
- Disposal of excavated soil at an EPA-approved disposal facility.
- Health education and outreach.
- Institutional Controls.

For Alternative 3, all residential properties with a quadrant showing a composite sample result greater than 400 ppm lead will be remediated. The drip zone may be remediated if the lead concentration in the drip zone of any remediated property exceeds 400 ppm lead. Residential properties where quadrant samples do not exceed 400 ppm lead would not be addressed under this action. Approximately 750 residences in Madison County remain to have their residential property soil sampled by the EPA. Under this alternative, the EPA will continue to seek access to and sample all residential properties within the Site to determine if they have been impacted by mining-related activities. Under this alternative, 300 residential properties are projected to possess lead soil concentrations greater than 400 ppm lead and will require excavating some or all portions of the property.

Under Alternative 3, it is estimated there will be 170 properties with lead soil concentrations between 400 ppm and 800 ppm (an assumed concentration for costing purposes only) and would be treated In situ with phosphate to reduce bioavailability of metals in the soil and thereby control the health risk to children. It is anticipated that phosphate, in the form of phosphoric acid, would be roto-tilled into the soil to a depth of 6 to 10 inches and allowed to stabilize for 7 to 10 days. Afterward, lime would be added to the property soil to raise the pH or otherwise neutralize the acidic condition created by the phosphate treatment, and the lawn would then be reestablished.

This alternative would not be implemented until a site-specific treatability study was completed to assess the effectiveness of phosphate stabilization on reducing lead bioavailability for the Site. The treatability study would consist of initial bench scale and bioavailability testing to determine the effect that phosphate addition, under ideal laboratory conditions, has on Site soils. The second part of the study, assuming initial findings are positive, would include testing of field application methods and phosphate application rates to most effectively lower the bioavailability of lead in the soil. Although site-specific treatability studies are necessary to determine the effect phosphate stabilization has on lowering the bioavailability of lead in residential soils, studies conducted by the EPA at other residential lead sites indicate that phosphate stabilization may be somewhat effective at lowering the bioavailability of lead exposure to young children. The final decision to proceed with phosphate stabilization of properties would be made by the EPA after peer review of the treatability study and public comments on the study.

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 residential properties with lead soil concentrations above 800 ppm, the EPA would remediate these properties using a similar methodology to that outlined in Alternative 2 – namely excavation, disposal and backfilling. Please see the previous section for details. It is estimated that approximately 130 residential properties possess lead soil contamination exceeding 800 ppm. Since an estimated 186 yd^3 of contaminated soil could be removed from each property, the estimated volume of soil would range up to 24,100 yd^3. The repositories, vegetation and restoration, health education, ICs (including the VICP) and groundwater components of Alternative 3 are the same as Alternative 2.

Land use and O&M would be similar to Alternative 2 above. However continued testing may be required to ensure the phosphate treatment remains successful over time.

Common Elements and Distinguishing Features of Each Alternative

Alternative 1 is removed from consideration because it is not protective of human health and the environment and does not meet ARARs. The two remaining alternatives, Alternatives 2 and 3, include the common elements of the selected repository (originally the Conrad tailings pile) and subsequently establishing a new, permanent repository that can also be utilized for future disposal by the public; vegetation restoration; health education; and the VICP. Both alternatives are similar in their attainment of key ARARs if the phosphate stabilization treatability study would prove successful for Alternative 3. A cost difference of approximately 27 percent is noted between the alternatives: Alternative 2 is projected to cost approximately $8.5 million; Alternative 3 is projected to cost approximately $11.5 million.

The key distinguishing features of these two alternatives are the number of yards to be excavated and the potential use of in situ phosphate stabilization in lieu of excavation and replacement. The use of phosphate treatment could reduce the overall volume of soil removed and requiring disposal by as much as 57 percent. Alternative 2 involves the excavation of all residential properties where a quadrant's sample exceeds 400 ppm for lead and does not provide in situ treatment. This alternative would be a final soil remedy for approximately 300 properties, the maximum estimated number of properties remaining to be remediated for this final ROD. Alternative 3 includes a combination of excavation and treatment to achieve the RAO for the estimated 300 residential properties at the Site with lead surface soil levels above 400 ppm. Excavation and replacement of lead-contaminated surface soil would be performed for an estimated 130 residential properties that exceed 800 ppm for lead, which is the anticipated treatment limit for phosphate stabilization. Concurrent with the construction for excavating the 130 properties that would require excavation, a treatability study would be performed to determine the effectiveness of phosphate stabilization to treat lead-contaminated surface soil with concentrations between 400 and 800 ppm lead for an estimated 170 properties. A treatability study is needed because phosphate stabilization of lead-contaminated residential soil has never been applied at full scale at lead-mining Superfund sites. If a phosphate stabilization treatability study was successful, the estimated 170 residential properties would be treated using this technology.

The primary distinction between Alternatives 2 and 3 involves the reliance upon a proven, conventional approach to remediation (excavation and replacement) versus consideration of a promising yet unproven technology (in situ phosphate stabilization treatment) to reduce risks in lead-contaminated surface soil to acceptable levels. Phosphate stabilization or treatment has been demonstrated to reduce bioavailability in some cases, thereby reducing risks associated with contaminated soil. However, the effectiveness of this technology under conditions at the Site remains uncertain as described in the study results of the Evaluation of Phosphate Treatment of Residential Properties, Omaha Lead Site, Omaha, Nebraska (see Attachment 2). Soil type and chemistry can be expected to impact the effectiveness of this type of technology. For this reason, a treatability study that successfully demonstrates the effectiveness of this technology applied to site-specific residential soil would be required before phosphate stabilization could be considered and applied at this Site. The long-term protectiveness and effectiveness of a surface soil excavation and replacement remedy, by comparison, are more assured.

Significant differences also exist between excavation and treatment with regard to management of lead-contaminated residential soil above 400 ppm. Under Alternative 2, excavation and replacement of lead-contaminated soil requires final management of remediated soil at a disposal location, such as the Conrad Repository or a future repository to be developed. The residual health risk associated with excavated soil and any clean soil and/or demarcation barriers would be controlled through the VICP at a local level but in coordination with the EPA until the Second Five Year Review, and with the MDNR during O&M. Contaminated soil at the repository would be controlled through covenant agreements with property owners under the MoECA to restrict future land use, and through engineering controls at the soil repositories. In contrast, under Alternative 3, if phosphate stabilization proved successful and treatment was used at a number of contaminated properties, treated surface soil would remain in place at the residential property. Residual risks associated with direct contact with the treated surface soil would be reduced to the acceptable level of 400 ppm lead or less.

The design timeframes and implementation associated with Alternatives 2 and 3 are very different. Alternative 2 requires very little design because similar residential property cleanups have previously occurred at a number of Superfund sites within the Region, as well as at OUs 1 and 3 for this Site. Additionally, excavation and replacement of contaminated surface soil is the conventional approach to lead-contaminated soil remediation and uses readily available equipment and standardized procedures. In contrast, a treatability study would be required that successfully demonstrates the safety and long-term effectiveness of the treatment technology and could require up to three or more years longer than Alternative 2 to complete. While Alternative 2 is expected to take four years, Alternative 3 could take more than a decade to complete with the inclusion of the treatability study and continued monitoring. If the treatability study did not demonstrate the effectiveness and permanence of the treatment technology, a remedy modification or amendment would be required for the approximately 170 residential properties with lead surface soil concentrations between 400 ppm and 800 ppm, resulting in further delays.

Long-term effectiveness and permanence factors are also different for Alternatives 2 and 3. For Alternative 2, at residential properties where no barrier is placed at depth, excavation and replacement of lead-contaminated surface soil provides immediate protection and permanence by replacement with clean soils to reduce human exposure potential. The long-term reliability of Alternative 2 is assured because there would be no surface soil with lead levels greater than 400 ppm. At properties where a plastic barrier is placed at depth, long-term reliability is high due to the placement of at least 12 inches of clean soil, which also provides a barrier between humans and contaminated soil left at depth. The rationale for establishing a minimum clean soil thickness of 12 inches is that the top 12 inches of soil is considered available for direct human contact. The remedy's permanence, in the case of properties with plastic barriers at depth, is tied to protecting the physical barrier and limiting disturbance of underlying, contaminated soil for both Alternatives 2 and 3, both of which would address this through the VICP. In contrast, phosphate stabilization under Alternative 3 would, again, require a long-term monitoring program to assess the long-term reliability and permanence considering that previous studies are inconclusive, and each site would require its own individual study.

As part of Alternative 3, the use of phosphate stabilization would constitute an innovative treatment remedy for lead-contaminated residential surface soil at the Site that would reduce toxicity. CERCLA establishes a statutory preference for remedies involving treatment that reduce the toxicity, mobility, or volume of hazardous substances. In comparison, Alternative 2, with its reliance on excavation, removal and disposal, does not treat or reduce the toxicity or volume of the hazardous substances (lead-contaminated residential surface soil.) However, the mobility of this soil would be reduced by its consolidation and control at a soil repository such as the Conrad tailings pile.

Expected Outcomes of Each Alternative

Both excavation and replacement of contaminated surface soil and implementation of successfully-demonstrated phosphate stabilization would allow for unrestricted future use at the majority of remediated properties, in addition to achieving the RAO for soil in preventing human exposure. Under both alternatives, it is anticipated that a small overall number of demarcation barriers will be required for placement at depth to indicate lead-contaminated residential soil remains beneath them. The barriers will require monitoring under the VICP and maintenance if disturbed. The VICP will ensure, if a barrier is disturbed, that the underlying soil will be properly disposed of and both the clean soil and demarcation barriers will be reconstructed to the condition accomplished at the time of remediation.

Potable water will be evaluated by sampling and analyses of groundwater from private wells under each alternative. Both alternatives provide for the reduction or elimination of COCs through filtering or treatment, well repair or replacement, or provision of an alternate water supply to achieve safe drinking water standards for potable water. The reduction or elimination of COCs that exceed safe drinking water standards will eliminate human exposure and allow for unrestricted, continued use of private well water.

Both excavation and replacement of soil and soil treatment are implementable, although phosphate stabilization has not been proven as an effective or permanent remedy and could only be used after a successful treatability study. Both could achieve meeting the RAOs, but Alternative 2 would not need to be proven through additional studies or continued monitoring.

The time frame to achieve cleanup goals is different for the alternatives. Excavation and soil replacement of a single property is typically performed within approximately five days. In comparison, phosphate stabilization of a property is expected to take approximately 15 days, meaning it would take approximately three times as long to remediate each residential property using phosphate stabilization. Seeding, hydroseeding and/or sodding would be applied with both alternatives and would require the same amount of additional time under either Alternative 2 or 3. Seeding or hydroseeding could require considerably more time and daily care to establish vegetation, depending on the season, compared to laying sod which will require frequent watering.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of alternatives using each of the nine evaluation criteria is presented in this section. The purpose of this analysis is to describe the common elements and distinguishing features unique to each response option as well as 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.

According to the NCP, nine criteria are used to evaluate the different alternatives individually and against each other to select the best remedy. The nine evaluation criteria are (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state/support agency acceptance; and (9) community acceptance. This section of the ROD profiles the relative performance of each alternative when measured against the nine criteria and each other. Seven of the nine evaluation criteria are discussed below. The state acceptance and community acceptance are presented in the ROD's Responsiveness Summary. A detailed analysis of these alternatives can be found in the FS Report.

The EPA will not address naturally-occurring lead ores in their undisturbed state as part of this action. Although the Site has been heavily mined in the past, it may still be possible to encounter naturally-occurring lead ores during excavation. Section 104(a)(3)(A) of CERCLA states that removal or remedial actions shall not be provided in response to a release or threat of release of a naturally-occurring substance in its unaltered form or altered solely through natural processes in a location where it is naturally found. Naturally-occurring lead ores could be found at the bedrock interface and in undisturbed clay soils near the surface. Another indicator of the presence of naturally-occurring lead ores could be a high density of galena crystals in soils or unusually high concentrations of lead in excavated soils. When these conditions are encountered, they will be documented, excavation will stop and backfill initiated.

Similar to the presence of naturally-occurring background COCs in soil at the surface, groundwater at private wells may also possess the presence of naturally-occurring minerals or compounds. Private wells drilled into granite or other igneous rock have the potential to possess elevated levels of fluorine as a result of the dissolution of naturally-occurring fluorite. Iron and manganese are also common in soils and geologic formations throughout the Site and are not exclusive to formations exploited for mining.

Private well construction and condition, well depth and the local geologic setting, in addition to geographic setting with respect to mine waste source locations, will be evaluated to assist in determining if the detection of COCs is a result of mine waste as opposed to naturally-occurring or background constituents during the RD/RA phase of the response actions.

1. Overall Protection of Human Health and the Environment: Determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Alternative 1 does not provide protection for the environment or residents at the Site because no actions are taken to mitigate the exposure to lead-contaminated soil. Alternative 2 would remove the significant exposure pathway associated with contaminated residential property soils. Once excavation, soil replacement and revegetation are complete and soils properly disposed of, the VICP would be fully implemented to monitor and address risks associated with any remaining contamination. Health education would continue, educating citizens and other stakeholders on effective ways to prevent human exposure to lead contamination. Potable groundwater at private wells would be assessed and, if determined contaminated above safe drinking water standards, corrective action would be implemented to reduce contamination to concentrations within safe drinking water levels. Therefore, Alternative 2 is protective of human health and the environment. As part of Alternative 3, a treatability study using residential property soil would be required to show that phosphate treatment of soil with lead concentrations between 400 ppm and 800 ppm would reduce the bioavailability of lead at the Site to levels that are protective of human health. Alternative 3 is protective of human health and the environment only if the phosphate treatment significantly reduces the bioavailability of lead on a long-term basis.

Two studies were conducted using phosphate treatment similar to that proposed for Alternative 3 as an alternative to address residential soil lead concentration between 400 ppm and 800 ppm. Based on these studies, the EPA is recommending that phosphate treatment no longer be considered as an alternative for the residential cleanup action at the Site. If phosphate treatment was capable of lowering the bioavailability of lead in soil by 50 percent or more, the technology might be appropriate for remediation of properties with lead concentrations of 800 ppm or less. However, if a 50 percent reduction in the bioavailability of lead cannot be consistently achieved, the technology may not be applicable to residential yards with lead contamination less than 800 mg/kg. 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. Some pilot and bench scale studies have demonstrated that phosphate treatment may reduce the bioavailability of lead to some extent, but the results have been inconclusive and do not confirm that the bioavailability of lead can be consistently reduced by 50 percent or more.

In addition, the phosphate treatment may lose its effectiveness over time. If the phosphate treatment does not permanently reduce lead bioavailability, the technology cannot be relied upon to provide long-term protection. The technology has some negative features, such as implementability and public acceptance. During the first 3 to 10 days after the addition of phosphoric acid, the soil will have a low pH near the surface which may pose a risk of irritation or burns to the skin following dermal contact. The phosphoric acid could damage the exterior of the 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 the property during treatment of the yard. The fence would have to remain until the lime was applied and the yard was sodded. 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. Depending on the method of applying the phosphoric acid, there would be a risk to workers from aerosol spray. Workers would be required to wear protective clothing, including respiratory protection, during the application of the phosphoric acid. Rototilling the property before the chemical addition and again following each of the two applications of the phosphoric acid could damage shrubs, trees, patios, sidewalks and driveways if not carefully performed. Rainfall occurring during treatment of a property would have the potential to increase the phosphorous concentration in the storm water runoff. Erosion control techniques would have to be implemented to prevent soil and chemicals from entering the storm water runoff. In addition, some health departments have opposed the use of the technology due to the continued presence of unacceptable lead concentrations in treated soils that would require continued monitoring to measure bioaccessibility, in addition to continued assessment of lead concentrations in soil to assure continued protectiveness.

2. Compliance with ARARs: Evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.

The ARARs for this Proposed Plan are included in Tables 3.1 through 3.6. The no-action Alternative does not comply with the ARARs. In contrast, Alternative 2, the excavation portion of Alternative 3, and the groundwater portion of both Alternatives 2 and 3 will comply with chemical and location-specific ARARs. Action-specific federal and state ARARs will be achieved by assuring contaminated soil exceeding the cleanup level is excavated, transported and properly disposed of, and potable water will meet the safe drinking water standards with any filters or collection of contaminants properly disposed. Storm water runoff will be addressed during excavation and soil replacement, and the use of best management practices will prevent erosion and runoff of sediment. Dust suppression will be used during all phases of construction both at residential properties and the repository, and the construction time will be minimized to reduce dust exposure potential to residents. Precautions will be considered at each location to ensure that excavation will not hinder or interfere with wildlife and local streams. The phosphate treatment portion of Alternative 3 would be dependent on the results of a treatability study to determine if all federal and state ARARs can be met. Please refer to the final paragraph under 1- Overall Protection of Human Health and the Environment.

3. Long-term Effectiveness and Permanence: Considers the ability of an alternative to maintain protection of human health and the environment over time.

Alternative 1 provides no long-term effectiveness or permanence for the protection of human health and the environment. Under Alternative 2 and the excavation portion of Alternative 3, the residual risks (those remaining after implementation) would be significantly reduced. Residential properties within the Site with soil concentrations at or above 400 ppm lead in Alternative 2, and greater than 800 ppm in Alternative 3, would have contaminated soil removed to a minimum depth of 12 inches or greater to achieve the lead cleanup level. The removal of contaminated soil, replacement with clean soil and revegetation ensures that future human exposure potential will be significantly reduced. Alternatives 2 and 3 provide permanence through complete removal and containment of contaminated soils at or above 400 ppm and at or above 800 ppm lead, respectively.

Both Alternatives 2 and 3 provide for the evaluation and selection of a technology to provide safe drinking water. The use of treatment systems and/or filters would require maintenance and filter replacement to maintain long-term effectiveness and permanence. However, Alternatives 2 and 3 could meet this criterion for well repairs, replacement wells or the provision of an alternate source of potable water through connection to a public water distribution system.

Alternatives 2 and 3 provide a permanent solution for continued health education, in addition to monitoring, testing and guidance for future handling of contamination through the VICP at a local level. However, funding to maintain the integrity of these programs may be needed indefinitely.

Previous studies have concluded that phosphate treatment can result in long-term reduction in the bioavailability of lead in soils. However, the treatment of residential soils using a phosphate amendment has not been implemented during a full-scale remediation project. The bench and pilot scale studies that have been performed have had mixed results, although the previous studies have generally indicated that the bioavailability of lead has not been reduced by more than 50 percent. The long-term effectiveness under Alternative 3 for phosphate treatment of lead concentrations between 400 and 800 ppm would be dependent on the results of a site-specific treatability study.

A significant aspect of Alternative 2 and the excavation portion of Alternative 3 is the placement of the contaminated soils at the Conrad Repository or a future developed repository, both of which require storm water and other design and engineering controls for long-term stability. Additionally, the establishment of a public use repository will be needed indefinitely to ensure long-term effectiveness because contamination will always remain on site; lead remaining in the subsurface at some locations, including unremediated locations or locations inaccessible during remediation, will likely be encountered at some time in the future and require disposal.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment: Evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

There is no reduction in the toxicity, mobility or volume of contamination under the no-action alternative (Alternative 1). Alternative 2 and the excavation portion of Alternative 3 would significantly reduce the mobility of the COCs by consolidation of the contaminated soils at the Conrad Repository or another approved disposal location. Although the exposure pathway would be eliminated or minimized, the toxicity and volume of the material would not be reduced by these alternatives with the exception of the treated and stabilized soils which would otherwise fail TCLP. The toxicity of the stabilized soils would decrease, although the volume of these soils is not expected to be a significant portion of the excavated residential soils. Proper long-term maintenance of the repositories is an important component of Alternatives 2 and 3 to ensure the significant reduction of heavy metal mobility.

The treatment portion of Alternative 3, assuming a site-specific treatability study would confirm phosphate stabilization would reduce the bioavailability of lead to acceptable health-based levels, would reduce the toxicity and mobility of the contamination. The volume of the contamination would not be reduced. However, the amount of soil requiring excavation and disposal would be significantly reduced over Alternative 2 because contaminated soil between 400 and 800 ppm would be treated in place at the residential properties. Please refer to the final paragraph under 1- Overall Protection of Human Health and the Environment.

For Alternatives 2 and 3, a reduction in the toxicity of groundwater upon distribution would be accomplished through the use of treatment and filtering. Permanent reduction to the entire source could be accomplished through well repair, well replacement or the provision of an alternate source such as connection to a public water supply.

5. Short-term Effectiveness: Considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

The short-term risk to workers for Alternative 1 is minimal since no remediation efforts will be performed. However, exposure pathways for the public and environment would remain. Alternative 2 has increased short-term risks for the public, construction workers and the environment 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 residents, community and workers during the remedial action. The alternative would require years to implement for all affected residences. However, the length of time at any one residence during excavation would be minimal. Therefore, the residential exposure to dust would be minimal. For Alternatives 2 and 3, the VICP and health education are in progress, and short-term exposure risks would be controlled through continued health education and the full implementation of the VICP. The Conrad Repository is available for disposal of contaminated soil generated by residents, local governments and contractors until a public use repository is developed.

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 application method for 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.

Alternative 1 would not provide for the groundwater measures that would be provided by Alternatives 2 and 3. For Alternatives 2 and 3, short term exposure risks could occur during the identification of contaminated potable groundwater diverted at private wells, and through delays in providing corrective measures. However, delays in implementing corrective measures could be minimized by providing bottled water until permanent corrective measures are employed.

6. Implementability: Considers the technical and administrative feasibility of implementing the alternative such as relative availability of goods and services.

Alternative 1 does not require any implementation. Alternative 2 and the excavation portion of Alternative 3, in addition to the groundwater portion of Alternative 2 and 3, are readily implementable because they are technically feasible from an engineering perspective. Excavation methods, backfilling and revegetation are typical engineering controls. The installation of filters and potable water treatment systems, in addition to repairs to existing well components or drilling of new wells, and connection to an alternate water supply (if available) can be readily achieved in terms of equipment and technology. The experience of previous site removal and remedial actions conducted by the EPA at this and other lead mining Superfund sites has shown that Alternative 2 and the excavation portion of Alternative 3, in addition to the potable water components of each, 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 uses 85 percent phosphoric acid, which 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 structure such as 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 the property during treatment of the property. The fence would have to remain until the lime was applied and the property was revegetated. 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 health risk to them. Please refer to the final paragraph under 1- Overall Protection of Human Health and the Environment.

The health education portion of Alternatives 2 and 3 is already implemented. The VICP has been developed and partially implemented with public and stakeholder input. The Conrad Repository will be used for disposal of lead-contaminated soil until a permanent public use repository is developed.

Potable water and well construction evaluations under both Alternatives 2 and 3 can be conducted in-house by the EPA without delays or future contracting, so implementation is feasible from an administrative perspective.

7. Cost: Includes estimated capital and operations and maintenance (O&M) costs as well as present worth costs (Table 6). Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

No capital or O&M costs would be associated with Alternative 1 because no remedial actions would be conducted. The present worth cost for Alternative 2 is estimated to be $8.5 million. The present worth cost for Alternative 3 is estimated to be $11.5 million. For both cost estimates, capital costs are spread over a construction period of two years. A 7 percent discount rate was used to calculate the present worth. These estimates are approximate and made without detailed engineering data. The actual cost of the project would depend on the final scope of the remedial action, actual length of time required to implement the alternatives and other unknown factors.

The historical average amount of soil removed from each property is 186 yd^3 at a construction-only cost of $63 per yd^3. This estimate is a general average considering past construction activities on this Site, but future costs could vary. For Alternative 3, the estimated costs of the phosphoric acid treatment could range from $12,305 for as little as one quadrant per property to $49,220 for an entire property.

For Alternatives 2 and 3, costs to address potable water for private wells are projected in the range of $600 for the basic installation of a filter system to as much as $7,000 for installing a new well, depending on the depth. Under both Alternatives 2 and 3, annual costs of $60,000 and $80,000 for the VICP and health education, respectively, would continue for four years and then be incorporated in the annual cost of O&M.

8. State/Support Agency Acceptance: Considers whether the state agrees with the EPA's analyses and recommendations of the RI/FS and the Proposed Plan.

MDNR staff generally support the Preferred Alternative (Alternative 2) proposed by the EPA. Typically, the MDNR has approved this same type of work in removal and remedial actions at this and other sites throughout Missouri. State acceptance was provided in a letter from the MDNR dated August 14, 2014.

9. Community Acceptance: Considers whether the local community agrees with the EPA's analyses and Preferred Alternative. Comments received on the Proposed Plan are important indicators of community acceptance.

In general, the local community, including local citizens and officials, support the Selected Remedy (generally presented in the Proposed Plan as the Preferred Alternative). A Responsiveness Summary, which captures public comments, has been included as part of the Interim ROD. The landowners of the Conrad tailings pile are willing to allow the EPA to use their property as the initial soil repository, and the City of Fredericktown and Madison County generally agree to allowing a lead-contaminated tract of land owned by the city to be used as the future public repository.

PRINCIPAL THREAT WASTES

According to the Office of Solid Waste and Emergency Response, OSWER Directive 9380.3-06FS, A Guide to Principal Threat and Low Level Threat Wastes, dated November 1991:

> *Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.*

Based on this definition, contaminated residential soil does not appear to be a principal threat waste because it is not a source material and therefore does not require treatment. The locations of mine waste at the Site are the ultimate source of the lead contamination in residential soil and will be addressed later under existing or future RODs. Additionally, the remaining lead-contaminated residential surface soil is neither highly toxic nor highly mobile in part because of previous removal and remedial actions. This final ROD allows the EPA to address the highest priority at the Site, human health risks posed by residential property surface soil, while additional evaluations are performed at other subsites on source materials.

SELECTED REMEDY

Summary of the Rationale for the Selected Remedy

The Selected Remedy for OU3 is Alternative 2 – Excavation, Disposal, Vegetative Cover, Potable Water Corrective Action, Health Education and Institutional Controls. The Selected Remedy was chosen over the other alternatives by the EPA because, among other reasons, it will achieve the RAOs and provides the best balance of the available options with respect to the nine NCP criteria. Alternative 2 is a continuation of the previous removal and remedial actions to excavate and replace lead-contaminated residential surface soil at the Site. Of the two alternatives which meet the threshold criteria, Alternative 2 is the better of the two with respect to long-term effectiveness and permanence because phosphate treatment's effectiveness is unknown due to the lack of a long-term study and the degree to which residual lead contamination, even though lower in bioavailability, would be accepted by homeowners and health officials. Alternative 2 is also better with respect to short-term effectiveness because soil disturbance activities will take less time at each property. Placing phosphate treatment materials on properties would require controls to protect residents and pets. With respect to implementability, Alternative 2 will be completed in a shorter time frame. Additionally, Alternative 2 is moderately less costly than Alternative 3. The EPA has met the RAOs at other lead mine-related Superfund sites by employing alternatives similar to Alternative 2 with respect to the key components. Finally, the VICP has been developed with community input and government stakeholders for this final ROD. Ultimately, ICs are needed by the EPA to ensure that the clean soil and demarcation barriers placed at depth, and the soil beneath them, is not disturbed for long-term protection of human health. Should disturbance occur, contaminated soil must be properly handled and disposed of. The VICP will also help the local community and government officials evaluate ways to safeguard future residential development while continuing to work with the federal and state stakeholders during the completion of the RA to further enhance its effectiveness during the remaining remedial actions.

The HHRA, which is the basis for the RAOs, clearly supports the need to take action at these high priority areas (residential properties) in a timely fashion, although remedial action continues under the OU3 IROD. However, due to the large number of residential properties remaining to be sampled and remediated, construction will likely take a minimum of two years to complete once the remedy is implemented. This remedy was selected to eliminate exposure of the site receptors to the COCs contained in surface soil and potable water diverted from private wells drawing from groundwater in the halo of mine waste impoundments, workings and outflows. Health education and the VICP will assist in maintaining the protectiveness of the remedy once construction is completed and should continue in perpetuity in order to ensure the protectiveness of the remedy.

Description of the Selected Remedy

The Selected Remedy is Alternative 2 — Excavation, Disposal, Vegetative Cover, Potable Water Corrective Action, Health Education and Institutional Controls. The Preferred Alternative was chosen over the other alternatives by the EPA because, based on the nine NCP criteria, it provides the best balance of available options and achieves the RAOs.

Under this alternative, the definition of a residential property includes residential yards, public areas and child high-use areas. Included with the remediation of residential properties are unimproved roadways, right of ways and storm water drainages. The EPA will continue to seek access to and complete sampling of all remaining residential properties that have not been sampled (estimated at 750) to determine the presence of lead contamination and eligibility for remediation. As many as 300 properties are projected to require remediation. If access is not granted by property owners to sample or remediate, other vehicles such as administrative action may be used to gain access.

A residential property with at least one quadrant testing greater than 400 ppm lead will be remediated. If the remaining drip zone of that property exceeds 400 ppm lead, the drip zone will also be remediated. A residential property with no quadrant exceeding 400 ppm lead will not be remediated under this action.

Soil Excavation: Remediation under this alternative will include the excavation and disposal of lead-contaminated soil, backfilling the excavation with clean soil, and restoration of all disturbed areas of the property to its original condition. Soil will be excavated using acceptably sized equipment suited to the size of the property to accommodate access and the ability to work within the property boundaries without disturbing adjacent properties. Hand tools will be used in areas where access is constrained and to prevent damage to buried utilities, tree roots, plantings, landscaping and other structures. Excavation will continue beneath the ground surface until the underlying soils at the base of the excavation are less than 400 ppm lead, or to a minimum depth of 12 inches if less than 400 ppm lead cannot be achieved within 12 inches bgs. An exception is garden areas where 400 ppm lead must be achieved down to 24 inches bgs.

If at 12 inches bgs the lead soil concentration is greater than 1,200 ppm, the EPA will approve excavation to a greater depth if it can be determined that a lead soil concentration below 1,200 ppm can be achieved within 24 inches bgs. If the EPA determines a lead concentration of less than 1,200 ppm concentration cannot be achieved within 24 inches bgs, the excavation will not continue and a demarcation barrier will be placed beneath the clean soil at 12 inches bgs.

The demarcation barrier will be an obvious, highly visible, plastic barrier that is permeable, wide meshed and will not affect soil hydrology or vegetation, such as an orange or red mesh plastic netting or construction fence. It will serve as a physical alert to anyone accessing the subsurface, indicating the presence of contaminated soil beneath it that poses a human health risk and should not be disturbed. The EPA recommends a minimum of 12 inches of clean soil be maintained at the surface to indefinitely serve as an adequate soil barrier to underlying soil that exceeds 400 ppm lead for protection of human health. The rationale for establishing this as a minimum thickness is that the top 12 inches of soil is considered available for direct human contact.

Based on the EPA's previous soil removal activities in and around Fredericktown, an average residential property will require removal and replacement of approximately 186 yd^3 of soil. Although this estimate could be considered high based on the 75 properties with only small areas of contamination identified along streets and in garden areas, the conservative approach is to calculate the property contaminated soil volume based on historic averages, since additional contamination could be identified during the excavation of any given residential property. Considering this, an estimated total of approximately 55,800 yd^3 of soil would require excavation, disposal and replacement. This estimate is used as the basis for part of the cost estimate for this remedial action.

Soil Disposal: The Conrad Repository will initially be used for the disposal of excavated soils. An additional repository is currently being considered for development. The new repository will also serve as a convenient, economical location for the public to dispose of contaminated soil encountered during home construction projects, city and county improvement projects and repairs, and possible new developments in the future. For contaminated soil or other mine waste determined to fail TCLP, a stabilization component such as phosphate may need to be mixed with it in order to be accepted for disposal at any approved disposal location.

After excavation and soil disposal, backfill and topsoil will be placed and the property will be graded to its original condition. The property will then be seeded, hydroseeded and/or sodded to restore the vegetation. Seeding or hydroseeding is preferred over sodding for its ease of initial maintenance and significant cost reduction. However, sod may be used at some or all locations on a property depending on specific property conditions such as steep slopes that would be subject to erosion before the vegetation could become established, or during periods outside of seeding windows to accommodate a property owner's use of the yard.

Potable Water Corrective Action: The current available data from private wells supports the theory that groundwater at residential wells outside of mine waste source locations has not been determined to be a Site concern, but may continue to be evaluated through the resampling of some private wells that were previously sampled by the EPA and MCHD. However, groundwater for potable use at private wells in the halo of mine workings, tailings and outflow locations could present a human health risk. Those private wells will be targeted for sampling, and the source and cause for contamination to the potable well water evaluated. Based on the results of the analyses and evaluation, corrective action will include one or a combination of the following to meet the EPA's safe drinking water standards in relation to the detected COCs exceeding its respective Primary MCLs, Secondary MCL or Action Level: filtering and/or treatment; well repair or replacement; and the provision of an alternate water supply through connection to a public water distribution system. Bottled water may be provided an as initial measure during the interim period after discovery of contamination until corrective action is completed.

Health Education: Due to the environmental problems associated with lead and other metals, in addition to the fact that lead contamination to some degree will always remain present at known and undisclosed locations across the Site, continued health education is necessary to assist in preventing activities that could result in human exposure leading to adverse health effects, and to maintain the already reduced frequency of elevated blood lead levels accomplished through the removal actions. Under this alternative, the established and active health education program would continue in cooperation with the EPA, ATSDR, MDNR, MDHSS and MCHD. Education would primarily be conducted by the MCHD. The following, although not an exhaustive list, indicates the types of education activities that will be continued at the Site:

- conduct extensive community-wide blood-lead monitoring,
- perform in-home assessments for children identified with elevated blood lead levels,
- distribute prevention information and literature,
- hold meetings with and act as a resource for area physicians of local families,
- provide community education through meetings; literature; talks and presentations at civic clubs, schools, nurseries, preschools, churches, fairs, etc.; and one-on-one family assistance,
- undertake special projects to increase awareness of how local citizens can protect themselves from heavy metal health risks, and
- contractor, local government and stakeholder training to educate on issues including lead exposure prevention, proper handling and disposal.

ICs: ICs are necessary to maintain the protectiveness of the remedy, both during the remedial actions and in perpetuity. Clean soil barriers and demarcation barriers must be maintained with limited disturbance to the underlying soil. If disturbance to a barrier or the underlying soil cannot be avoided, barrier repair or replacement and proper handling and disposal of contaminated soil is necessary to prevent recontamination at the surface of the same property or other locations.

While the EPA has considered proprietary controls in the form of restrictive covenants, these controls present a greater difficulty at this Site given that over 1,600 residential properties in the project area have been remediated, and a number of properties will possess demarcation barriers with contamination remaining beneath them at the close of construction. Additionally, Madison County is a state-designated "Class 3" county as a result of its assessed valuation and population, which limits its authority to develop ordinances and impose taxes to administer and maintain local controls.

For these reasons, a Voluntary IC Program was developed during the IROD remedial activities in conjunction with concerned citizens and government stakeholders, resulting in a local program to be operated by the MCHD. Currently funded through cooperative agreements between the EPA and MDHSS, this program focuses on monitoring and testing residential properties, preventing disturbances to soil/demarcation barriers and contaminated soil, ensuring the proper handling and disposal of contaminated soil if a disturbance occurs, and proper disposal of contaminated soil. A VICP Manual has been developed for use by all stakeholders as a guide to encountering, handling and disposing of lead contamination.

The MCHD has been provided access to the EPA's Residential Lead Database to initiate monitoring properties as a function of the VICP, in addition to keeping the database content current with respect to property owner and contact information. The MCHD will alert citizens and contractors of any known contaminated soil conditions at residences warranting special attention by monitoring local building permits and the Missouri Dig-Rite database as vehicles to trigger a local oversight response for any projects involving soil disturbances. The MCHD has acquired an XRF to analyze soil for the presence of lead contamination and is assisting in providing proper instruction for maintaining soil and demarcation barriers and the handling and disposal of contaminated soil to ensure properties are not recontaminated and remain protective of human health. The health education program and the VICP will also incorporate training of local city and county government officials to garner their cooperation in monitoring both their own and subcontracted construction and repair activities for roads, right-of-ways, storm water drainages, and infrastructure projects..

The VICP will be evaluated in four years as part of the next Five Year Review period to determine its viability and effectiveness. Should it be determined to fail to ensure long term protectiveness, options to continue other ICs could rely on exclusive or combined components that include formal adoption of health ordinances, agreements with local governments, and/or covenants with property owners through the MoECA with long term stewardship monitoring.

The future land use of the remediated residential properties is not anticipated to change. With adequate remediation, continued health education and successful management of the VICP, the land use will actually be enhanced. Lead-contaminated soil that could otherwise pose a human health risk will be excavated and clean soil replaced to a minimum depth of 12 inches bgs. Health education will continue to educate school-aged children, the community and all stakeholders on the dangers of lead contamination, further reducing the potential risk of exposure.

Based upon the information currently available, the EPA believes the Selected Remedy meets the threshold criteria and provides the best balance of available options among the other alternatives with respect to the balancing and modifying criteria.

Summary of the Estimated Remedy Costs

The present worth cost for Selected Remedy - Alternative 2 is estimated to be $8.5 million and is presented in Table 6. The capital costs are spread over a construction period of four years. A 7 percent discount rate was used to calculate the present worth. A present worth analysis was performed to evaluate project costs over four years and is included in the table. This estimate is approximate and made without detailed engineering data. The information in Table 6 is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the implementation of the remedial action. Major changes, if they arise, may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or an amendment to this final ROD. This is an order-of-magnitude engineering cost estimate that is expected to be accurate within +50 to -30 percent of the actual project cost.

Expected Outcomes of the Selected Remedy

The Selected Remedy will provide an accelerated response to residential property surface soil contaminated with lead above the cleanup level and will significantly improve human health protection in the community. Remediated properties will meet the cleanup criteria of less than 400 ppm lead in surface soil and corrective action to potable water at private wells will achieve safe drinking water standards based on the HHRA and RAOs. The Selected Remedy will take an estimated two years to construct once implemented due to the large number of properties involved. The Selected Remedy at properties where barriers are placed at depth will ultimately be monitored and preserved under the VICP management at a local level.

Continued residential use will be enabled at all remediated properties under the Selected Remedy. Land use may actually be enhanced because lead-contaminated surface soil that would otherwise pose a human health risk will be excavated from the vast majority of residential properties. Residential properties with contamination left at depth will have a demarcation barrier in addition to a minimum 12-inch clean soil barrier. The VICP will be in place to protect the barriers, and the minimum 12-inch clean soil barrier at the surface will be available for unrestricted use and direct human contact under this alternative.

STATUTORY DETERMINATIONS

The EPA expects the Selected Remedy to satisfy the following statutory requirement of section 121(b) of CERCLA: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element or explain why the preference for treatment will not be met. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment at remediated residential properties by achieving the RAOs through conventional engineering measures and ICs. Risks associated with lead-contaminated residential soils at the Site are caused by the potential for direct contact with contaminated soils and potable groundwater from private wells. The Selected Remedy eliminates this direct exposure pathway through excavation and replacement of lead-contaminated soils at the residential properties. Contaminated soils will be removed from residential properties, permanently eliminating this identified source of exposure. Corrective action to potable water diverted for use from private wells in the halos of mine waste sources will eliminate risks from ingestion of contaminated groundwater by reducing the concentrations of COCs to within safe drinking water standards. The implementation of the Selected Remedy for soil and groundwater will not pose unacceptable short-term risks or result in cross-media impacts.

Health education will continue in perpetuity to educate citizens, contractors and all other stakeholders, keeping them informed of the dangers of lead and exposure prevention. The community will become aware that living with lead will always be a concern due to the widespread nature of lead contamination, but that living in the presence of lead contamination does not have to result in adverse health effects.

The VICP will address contaminated soil that remains on site by placing the necessary controls in local hands to prevent recontamination of remediated properties and new contamination of residential properties from off-site source locations. Monitoring of the Site will be maintained by utilizing the EPA Residential Soils Database, monitoring local building permits and accessing Dig-Rite to determine where disturbance to soils is scheduled to occur. Testing will be performed by the MCHD to determine the presence of contamination (if unknown), and to provide immediate guidance to prevent damage to barriers and ensure proper handling and disposal of contaminated soils. A new local repository will be made available for residents, contractors, local cities and the county to dispose of lead contamination generated during construction, new development, and maintenance/repair projects.

Compliance with ARARs

The Selected Remedy is expected to meet all chemical-specific, action-specific, and location-specific ARARs and does not involve any waivers. Because there are many ARARs, the ARARs for this final ROD are included in Tables 3.1 through 3.6. Additionally, if the EPA and MDNR determine there are other documents that should be considered to assist in ensuring protectiveness or are appropriate for use with regard to the Selected Remedy, such non-binding criteria are commonly referred to as To Be Considereds (TBCs). However, no TBCs were identified for this Selected Remedy.

Cost Effectiveness

In the EPA's judgment, the Selected Remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost effective if its costs are proportional to its overall effectiveness" (NCP 300.430[f][1][ii][D]). It relies on conventional engineering, construction and corrective action methods. Contaminated soils are removed and replaced, thereby providing a permanent remedy for remediated residential soils which should not be subject to future costs and in most cases provides for unrestricted use.

The cost difference between the Selected Remedy (Alternative 2) estimated at $8.5 million and the other alternative that meets the threshold criteria (Alternative 3) estimated at $12.5 million is approximately 33 percent. Since the effectiveness of a large part of Alternative 3 depends on a successful treatability study and continued monitoring to determine that phosphate stabilization will and continues to provide permanence and long-term protectiveness, costs could range higher. The excavation and replacement of contaminated surface soil in the Selected Remedy under Alternative 2 has the highest level of short- and long-term effectiveness and permanence of the alternatives evaluated.

The VICP will be utilized to prevent new or recontamination of properties and will thereby effectively reduce future potential costs to remediate a property. Health education and the VICP at the local level will reduce future costs through prevention of recontamination of properties, and also will provide readily accessible testing and guidance to address lead contamination and reduce human exposure potential indefinitely.

Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The EPA has determined that the Selected Remedy, among the alternatives evaluated, is the one with the best balance of available options with respect to the balancing criteria in the NCP, while also considering the statutory preference for treatment as a principal element. When the Selected Remedy is in place, it will provide for a permanent solution to eliminating exposure risks to humans given that the constructed components for soil and the corrective action for potable water are maintained and repaired as needed.

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at this Site. The EPA has determined that the Selected

Remedy provides the best balance of trade-offs with respect to the balancing criteria and bias against off-site treatment and disposal, and considering State and community acceptance. The Selected Remedy uses a well-demonstrated remediation approach considered reliable and cost effective considering the volume of waste present. The constructed components will provide physical barriers to eliminate COC exposure, monitored under the VICP in conjunction with O&M to be provided by the MDNR. Short-term risks during construction can reasonably be controlled through best management practices such as watering for dust control, controlling precipitation runoff, and through construction site safety training of employees working under well-developed health and safety plans and required attendance at safety meetings.

Preference for Treatment as a Principal Element

The Selected Remedy does not utilize treatment to address the principle threats posed by the residential property soil. No treatment technologies were identified that have definitively demonstrated the ability to reliably provide short- and long-term effectiveness, permanence, and meet the other NCP criteria. For a very small percentage of contaminated residential soil, lead stabilization treatment may be needed to prevent the soil from failing TCLP. However, the volume of such soil is expected to be a negligible portion of the total excavated residential soils. Additionally, for a subset of private wells, potable water treatment and/or filtering will be utilized if contamination results from dissolved phase metals or suspended solids in groundwater from mine waste sources, as opposed to contamination by direct surface runoff impacting otherwise clean water in a well through a damaged well component.

Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review is required. Five year reviews are required after initiation of the remedial action to ensure that the remedy is or will be protective of human health and the environment in accordance with CERCLA 121(c) and the NCP at 40 CFR § 300.430(f)(5)(iii)(C). Initiation of remedial action was determined by the "actual RA on-site construction" date that triggers the review. The initial Five Year Review was completed in September 2013, and the Second Five Year Review is scheduled for completion in 2018.

DOCUMENTATION OF SIGNIFICANT CHANGES

The EPA reviewed all written and verbal comments submitted during the public comment period. Although not considered significant based on the estimated cost range variance (+50 to -30 percent), the following change was made.

A slight adjustment to the capital and present worth cost is noted in this ROD compared to the Proposed Plan as a result of a calculation field error. Originally, the VICP line item cost was only carried into the Present Worth Analyses (under the Annual Capital Costs column) for the first operation year, but should have carried through the remaining three years. The correction includes that the $60,000 annual VICP be carried through all four operation years increasing the original total capital cost of $9,816,000 to $9,996,000 (rounded from $9.8 million to $10.0 million), and the original present worth cost from $8,317,000 to $8,464,641 (rounded from $8.3 million to $8.5 million).

GLOSSARY OF TERMS

This glossary defines many of the technical terms used in relation to the Madison County Mines Site in this ROD. The terms and abbreviations contained in this glossary are often defined in the context of hazardous waste management and apply specifically to work performed under the Superfund program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record (AR): All documents which the EPA considers or relies upon in selecting the response action at a Superfund site, culminating in the Record of Decision for remedial action.

Baseline Human Health Risk Assessment (BHHRA): A document that provides an evaluation of the potential threat to human health in the absence of any remedial action.

Bioavailability: A risk assessment term; the fraction of an ingested dose that crosses the gastrointestinal epithelium in the stomach and becomes available for distribution to internal target tissues and organs.

Blood lead level or concentration: The concentration of lead in the blood, measured in micrograms of lead per deciliter of blood (μg/dL).

Capital Cost: Direct (construction) and indirect (non-construction and overhead) costs including expenditures for equipment, labor and materials necessary to implement remedial actions.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The acts created a special tax that went into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, the EPA can either: (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back the federal government for the cost of the cleanup.

Contaminant: Any physical, chemical, biological or radiological substance or matter that can have an adverse effect on human health or environmental receptors.

Chemicals of Concern (COC): A substance detected at a hazardous waste site that has the potential to affect receptors adversely due to its concentration, distribution and mode of toxicity.

Discount rate: A percentage rate used in present worth analyses to identify the cost of capital and operation and maintenance expenses. It is used to value a project using the concepts of the time-value of money where future cash flows are estimated and discounted to give them a present value.

Dolomite: A sedimentary rock containing greater than 50 percent of the mineral dolomite; often found with calcite in forming limestone, another sedimentary rock.

Exposure pathways: The course a chemical or physical agent takes from a source to an exposed organism. Each exposure pathway includes a source or release from a source, an exposure point and an exposure route.

Feasibility Study (FS): A report that analyzes the practicability of potential remedial actions; that is, a description and analysis of potential cleanup alternatives for a site on the National Priorities List.

Groundwater: Water filling spaces between soil, sand, rock and gravel particles beneath the earth's surface, which often serves as a source of drinking water.

Interim: Temporary or provisional efforts that address a portion of the Madison County Mines Site on a temporary basis until the final remedy for the entire operable unit is implemented.

Limestone: A common sedimentary rock consisting mostly of calcium carbonate and aragonite.

Maximum Contaminant Levels (MCLs): Concentrations established by the EPA in conjunction with the Safe Drinking Water Act to define the maximum concentration for contaminants in public drinking water supplies.

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

National Priorities List: The EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System.

Operation and Maintenance (O&M): Activities conducted at a site after response actions occur to ensure that the cleanup or containment system continues to be effective.

Preliminary Remediation Goals: Site-specific concentration values set as cleanup targets based on known and projected human health and ecological risks.

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

Proposed Plan: A plan for a site cleanup that is available to the public for comment which summarizes remedy alternatives and presents the EPA's Preferred Alternative or cleanup approach.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at a National Priorities List site.

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action and support technical and cost analyses of alternatives. The RI is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Removal action: Short-term immediate action taken to address releases of hazardous substances that require an expedited response.

Responsiveness Summary: A summary of oral and/or written public comments received by the EPA during a comment period on key EPA documents and the EPA's response to those comments.

Toxicity: The degree to which a chemical substance (or physical agent) elicits a deleterious or adverse effect upon the biological system of an organism exposed to the substance over a designated time period.

RESPONSIVENESS SUMMARY FOR THE RECORD OF DECISION

Madison-Wide Residential
OPERABLE UNIT 03
Madison County Mines Superfund Site
Madison County, Missouri

This Responsiveness Summary has been prepared in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act, and the National Contingency Plan, 40 CFR § 300.430(f). This document provides the U.S. Environmental Protection Agency's response to all significant comments received from the public on the Proposed Plan for the OU3 portion of the Madison County Mines Superfund Site during the 30-day comment period.

The Responsiveness Summary consists of the following three components: an overview of the public process, responses to verbal questions received at the public meeting and responses to written correspondence received during the public comment period. This document is provided to accompany the Record of Decision and reflects input resulting from the public comment process.

Overview

The Proposed Plan and supporting documents included in the Administrative Record (AR) were made available for public review and comment for 30 days from July 17 to August 17, 2014. No potentially responsible parties are being pursued for these actions. A public meeting was held at the Site at the Mineral Area College Fredericktown Outreach Facility in Fredericktown, Missouri, on July 17, 2014. Aside from the EPA hearing officer, presenter and CIC representative, 12 attendees were present. Only one citizen was present with the remaining attendees representing the MDNR, MDHSS, MCHD, the city of Fredericktown and Madison County.

One verbal statement by a city of Fredericktown representative was made during the question and answer session. The statement, which did not solicit a response, involved information concerning Fredericktown City Lake (part of OU1) and was deemed irrelevant to the Proposed Plan. This statement is included in the transcript of the Proposed Plan public meeting and is included in the Site record.

One letter was received during the 30-day public comment period. Submitted by the MDNR, the letter generally supports the Preferred Alternative in the Proposed Plan and is included as Attachment 1.

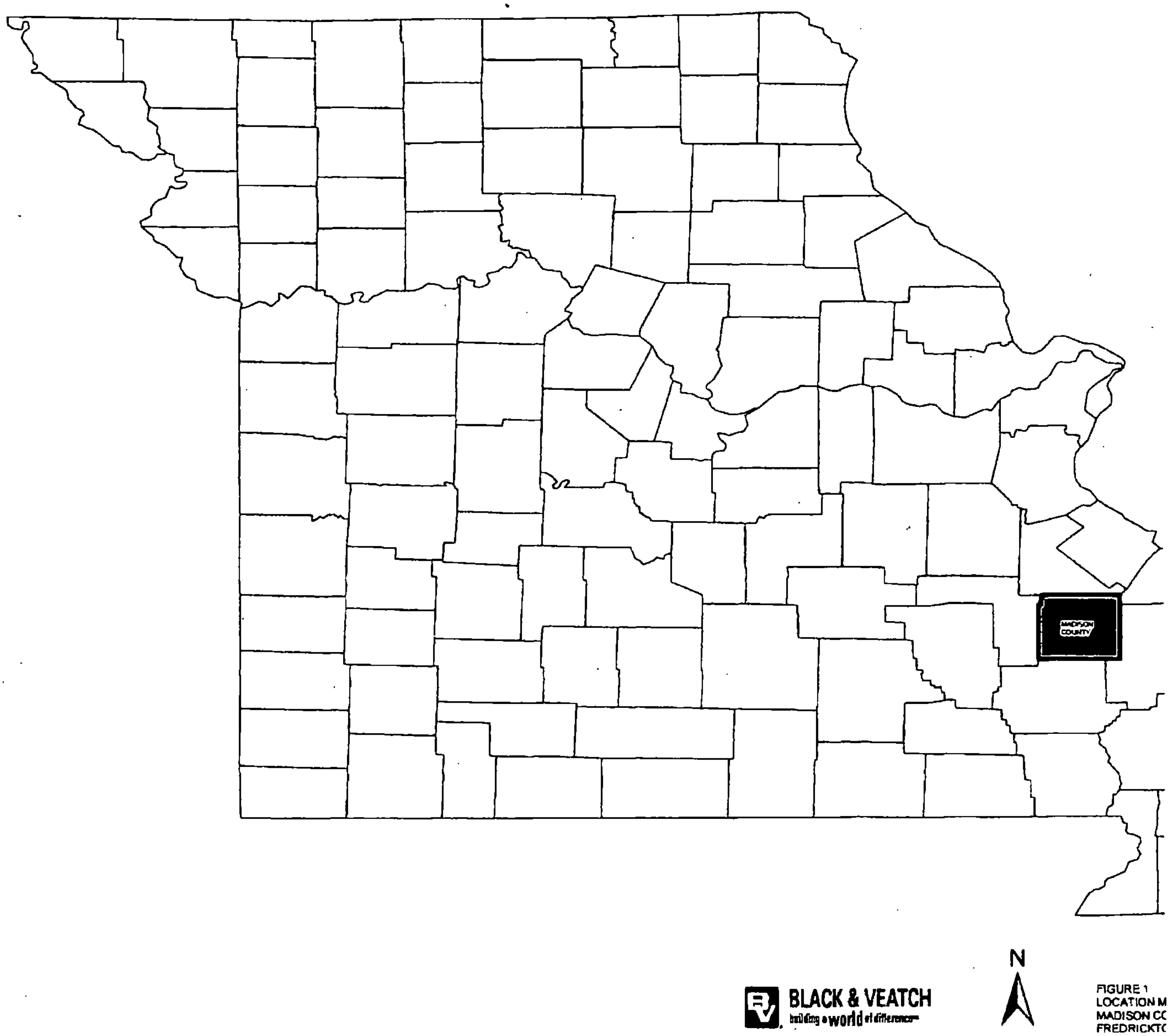
Responses to Verbal Questions

No verbal questions were presented by any attendees at the Proposed Plan public meeting, therefore no responses are included in this responsiveness summary.

Response to Written Correspondence

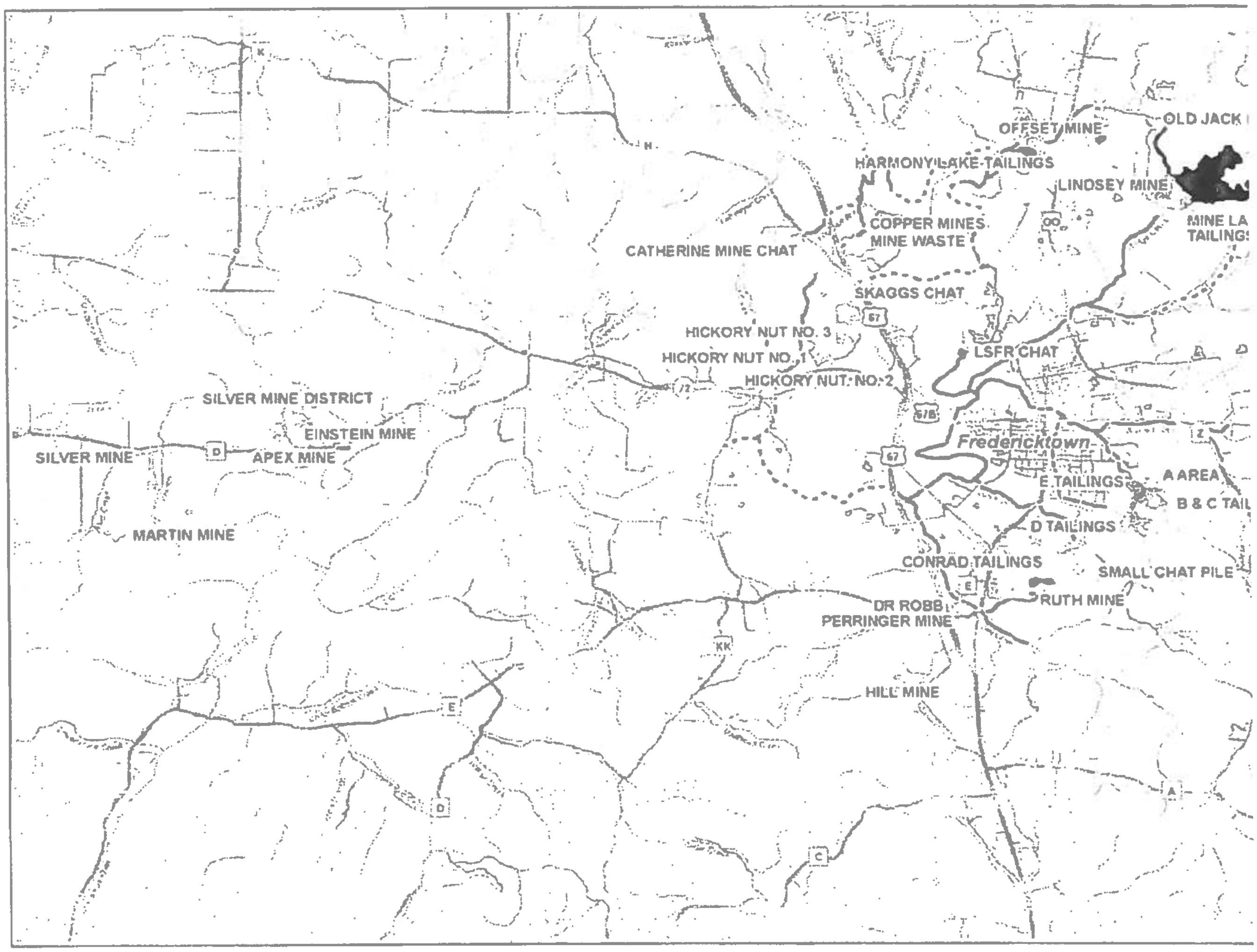
The MDNR provided a letter generally concurring with the preferred final remedial alternative presented in the Proposed Plan. No other written correspondence was received during the public comment period.

FIGURES



BLACK & VEATCH
building a world of difference

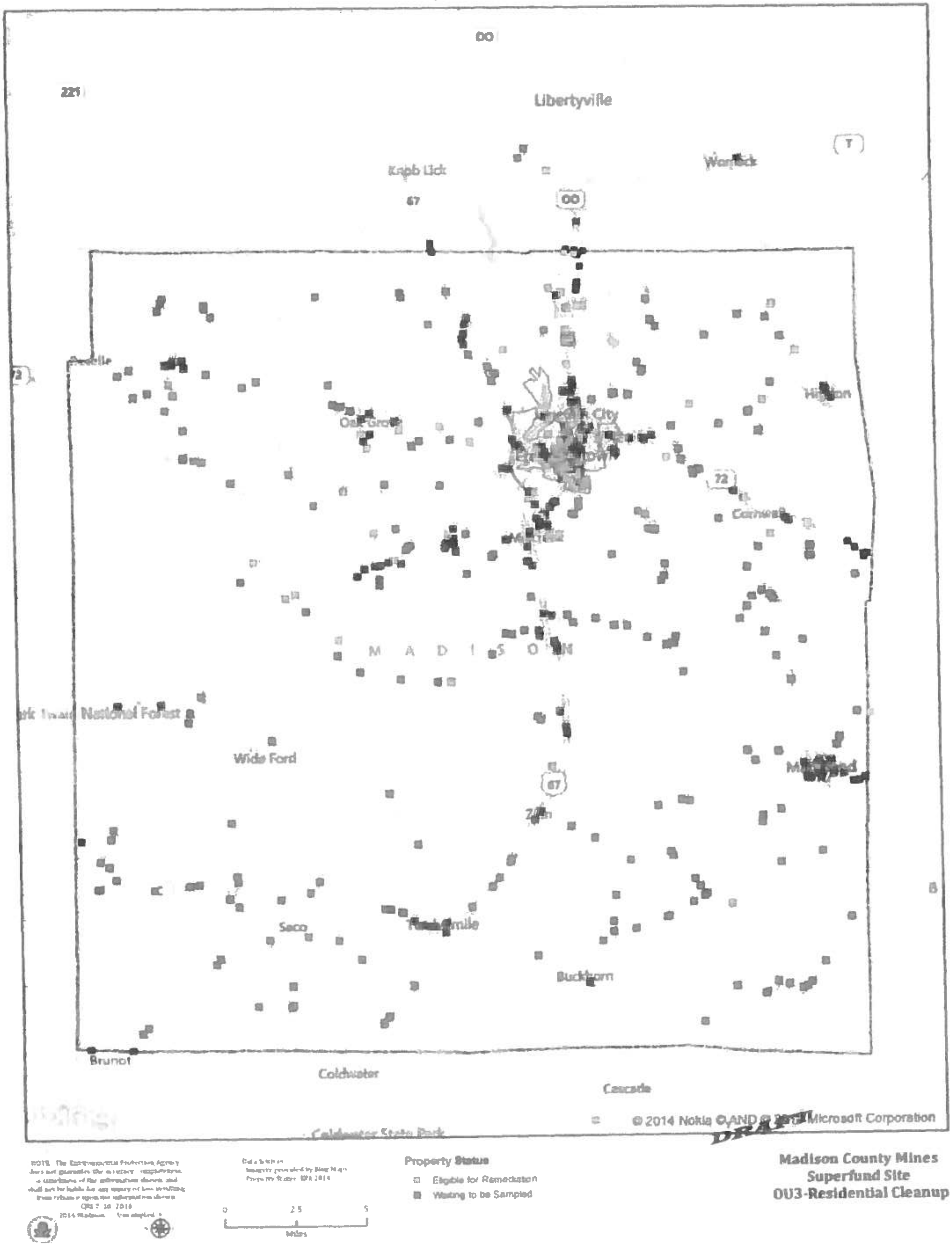
FIGURE 1
LOCATION M
MADISON CC
FREDRICKTC



OFFSET MINE
OLD JACK
HARMONY LAKE TAILINGS
LINDSEY MINE
MINE LA
TAILING
COPPER MINES
MINE WASTE
CATHERINE MINE CHAT
SKAGGS CHAT
HICKORY NUT NO. 3
HICKORY NUT NO. 1
HICKORY NUT NO. 2
LSFR CHAT
SILVER MINE DISTRICT
EINSTEIN MINE
SILVER MINE
APEX MINE
Fredericktown
E TAILINGS
A AREA
B & C TAIL
D TAILINGS
MARTIN MINE
CONRAD TAILINGS
SMALL CHAT PILE
DR ROBB
PERRINGER MINE
RUTH MINE
HILL MINE

Figure 3

Remaining Properties to Sample and Remediate



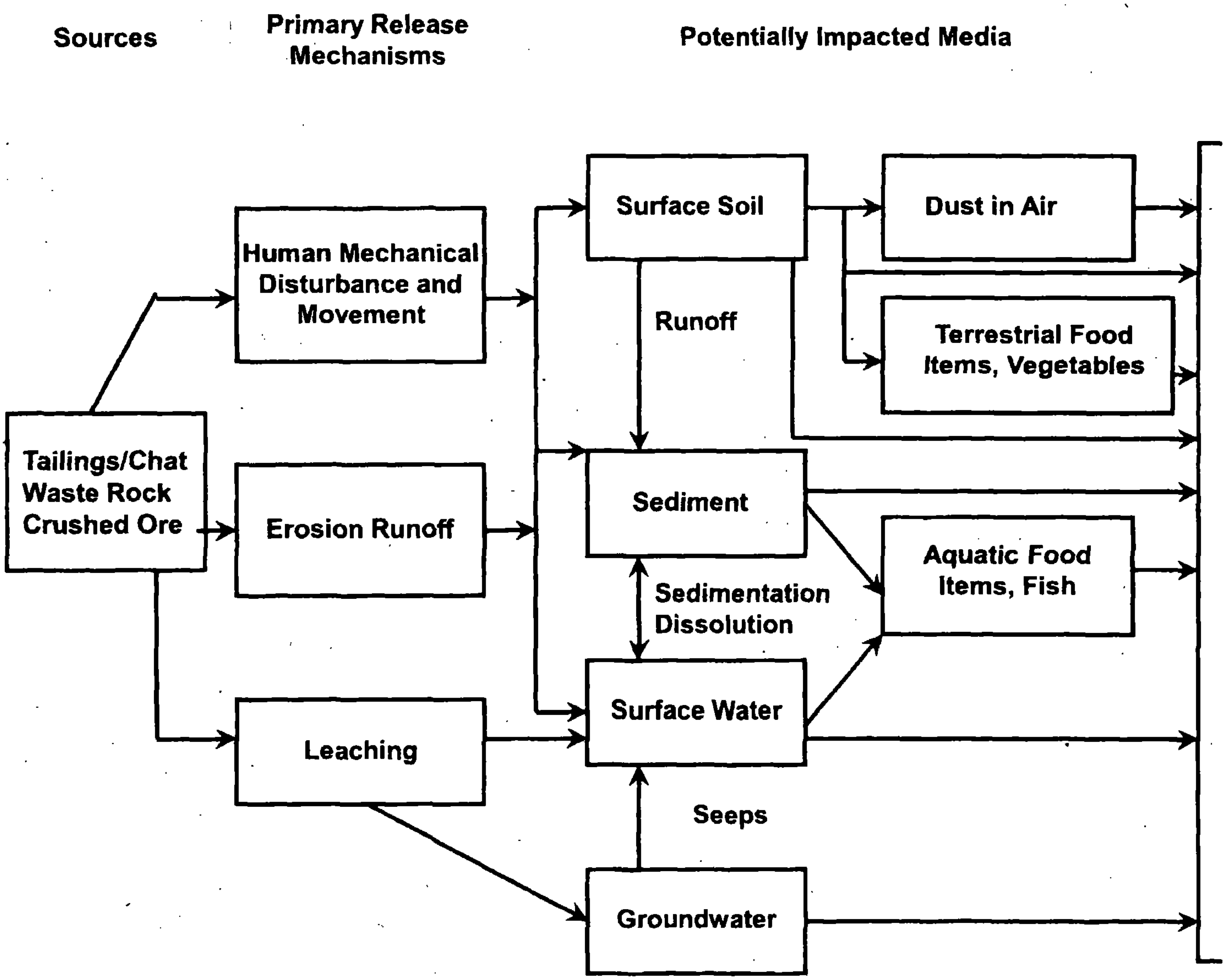


Figure 4
Conceptual Site Model
Madison County Mines Site
Fredericktown, MO

TABLES

Table 1 - Site Chemicals of Potential Concern
for the Human Health Risk Assessment

CHEMICAL	SURFACE SOIL	SEDIMENT	SURFACE WATER	GROUNDWATER	FISH TISSUE
Aluminum	x	x			
Antimony	x	x	x	x	
Arsenic	x	x	x	x	x
Barium	x	x			
Beryllium					
Cadmium	x	x		x	x
Calcium					
Chromium	x	x		x	
Colbalt	x	x	x	x	x
Copper	x	x		x	x
Fluorine	NA	NA	NA	x	
Iron	x	x	x	x	
Lead	x	x	x	x	x
Magnesium					
Manganese	x	x	x	x	
Mercury	x	NA	x	NA	
Molybdenum		NA			
Nickel	x	x	x	x	x
Potassium					
Selenium			x	x	x
Silver	x				
Thallium	x	x	NA		
Tin		NA		NA	
Titanium	NA	NA			
Vanadium	x	x	x		
Zinc	x			x	x

NA= Chemical not analyzed (no data to evaluate).

Table 2

Current Risk to Children from Ingestion of Lead in Surface Soil and Groundwater

Summary of Risks to Child Residents from Exposure to Lead in Surface Soil

ESTIMATED NUMBER AND PERCENT OF PROPERTIES WITHIN THE SPECIFIED P10(%) RANGE					
	≤5%	>5% to ≤10%	>10% to ≤20%	>20% to ≤50%	>50%
# of properties	799	47	32	55	37
% of properties	82%	5%	3%	6%	4%

Notes:
P10 - Probability of exceeding a blood lead value of 10 ug/dL (%)

Summary of Risks to Child Residents from Exposure to Lead in Groundwater

Exposure Unit (Well)	P10 (%)
20011	0%
20008	0%
20001	0%
20003	0%
20004	0%
20005	0%
20006	0%
20007	0%
20009	0%
20010	0%
20012	0%
20018	0%
20020	0%
20021	0%
20022	0%
20023	0%
20024	0%
20025	0%
20027	0%
20028	63%
20030	0%

Exposure Unit (Well)	P10 (%)
20031	0%
20032	0%
20033	0%
20034	0%
20035	0%
20036	0%
20037	0%
20038	0%
20039	0%
20040	0%
20041	0%
20042	0%
20043	0%
20044	10%
20047	0%
20013	0%
20014	0%
20015	0%
20016	0%
20017	0%
20019	0%

Notes: Shading indicates a P10 value (probability of a blood lead level exceding 10 ug/dl) that exceeds 5%

Hatching indicates a P10 value greater than 5%, EPA's health protection goal for children and lead. Upon resampling, these wells yielded results less than the Maximum Contaminant Level for lead. These wells will be evaluated in the future, with a final decision for them made in the final Record of Decision for Operable Unit 3.

The groundwater results represent the total or unfiltered fraction of lead in groundwater.

Table 3.1
Federal Chemical-Specific ARARs

	Citations	Description
A. ARARs		
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 base
2. Safe Drinking Water Act	National Secondary Drinking Water Standards 40 C.F.R. Part 143	Establish secondary maximum contaminant levels (SMCLs) which are systems to protect the aesthetic quality of the water. SMCLs may be rel 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 ar anticipated adverse health effects. The MCLGs include an adequate m
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 re 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 an
7. Residential Lead-Based Paint Hazard Reduction Act	Toxic Substances Control Act (TSCA) Disclosure Rule 1018, August 2009. 40 C.F.R. Part 745.220 Subpart I.	Requires persons conducting lead-based paint activities, which include follow certification requirements and work practice standards
B. To Be Considered		
1. EPA Revised Interim Soil-lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities and 1998 Clarification	Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-12, July 14, 1994, OSWER Directive 9200.4-27P, August 1988	Establishes screening levels for lead in soil for residential land use, des preliminary remediation goals, and describes a plan for soil-lead cleanu recommends using the EPA Integrated Exposure Uptake Biokinetic Mc 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 child lead exposure to the greatest extent possible. Goals of the strategy are t above 10 µg Pb/dL in children; and 2) reduce the amount of lead introd
3. Human Health Risk Assessment Report (HHRA)	"Area-Wide Human Health Risk Assessment for the Madison County Mines Site, Madison County, Missouri" – prepared by Syracuse Research Corp., July 2007	Evaluates baseline health risk due to current site exposures and establis media at the site for the protection of public health. The risk assessmen determining cleanup levels because ARARs are not available for contai
4. Superfund Lead-Contaminated Residential Sites Handbook	EPA OSWER 9285.7-50, August 2003.	Handbook developed by EPA to promote a nationally consistent decisi managing risks associated with lead contaminated residential sites acro
5. Preliminary Remediation Goals	Preliminary Remediation Goals for Lead in Soil at the Madison County Mines, Operable Unit 3 Site, Madison County, Missouri, January 31, 2008.	Establishes preliminary remediation goals for protection of residents fr County Mines Site, Operable Unit 3.

Table 3.2
State Chemical-Specific ARARs

	Citation	Description
A. ARARs		
1. Missouri Air Conservation Law	Missouri Department of Natural Resources RSMo 643.010 10 CSR 10-6.010	Sets ambient air quality standards for a variety of constitu lead. Provides long range goals for ambient air quality thr the public health and welfare.
2. Hazardous Waste Management Law	Missouri Department of Natural Resources Identification and Listing of Hazardous Waste 10 CSR 25-4.261 (A) 1, 2, 4	Defines those solid wastes which are subject to regulation 25.
3. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20-7.015 (1) (2) (3) (4) (5) (6) (7) (9)	Sets forth the limits for various pollutants which are disch Sets effluent standards that will protect receiving streams.
4. Missouri Clean Water Law	Missouri Department of Natural Resources RSMo 644.006 10 CSR 20 – 7.031 (2) (3) (4) (5); Tables (A) (B)	Identifies beneficial uses of waters of the State, criteria to degradation policy.
B. To Be Considered	None	

Table 3.3
Federal Location-Specific ARARs

	Citation	Description
A. ARARs		
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 R 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 may contain historical and archaeological d 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 rem conserve endangered or threatened species and their habitat, including consu 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 may take place within a 100-year floodplain. The remedial adversely impacting the floodplain in and around the soil repository to ensur 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 wherever possible including minimizing wetlands destruction and preservin
6. Waters 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 o dredged material are examples of activities that may involve a discharge of c Four conditions must be satisfied before dredge and fill is an allowable alten 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation of State v applicable toxic effluent standards, jeopardize threatened or endangered spe 3. No discharge shall be permitted that will cause or contribute to significan 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and biological

Table 3.3 (Continued)
Federal Location-Specific ARARs

A. ARARs (Continued)	Citation	Description
7. Area containing fish and wildlife habitat in and around the removal repository.	Fish and Wildlife Conservation Act of 1980, 16 U.S.C. Part 2901 et seq.; 50 C.F.R. Part 83.9 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 a non-game fish and wildlife and their habitats.
8. Fish and Wildlife Coordination Act	16 U.S.C Section 661 et seq.; 33 C.F.R Parts 320-330; 40 C.F.R 6.302	Requires consultation when a Federal department or agenc stream or other water body, and adequate provision for pro
9. 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 lo constructed, operated, and maintained to prevent washout
10. Historic Site, Buildings, and Antiquities Act	16 USC Section 470 et seq., 40 CFR Sect. 6.301(a), and 36 CRF, Part1.	Requires Federal agencies to consider the existence and lo Natural Landmarks and to avoid undesirable impacts on su
11. Clean Air Act	National Ambient Air Quality Standards/ NESHAPS 42 U.S.C. 74112; 40 C.F.R. 50.6 and 50.12	Emissions standards for particular matter and lead.
B. To Be Considered	None	

Table 3.4
State Location-Specific ARARs

	Citation	Description
A. ARARs		
1. Missouri Wildlife Code	Missouri Department of Natural Resources 3 CSR Sec. 10 – 4.111	Requires a determination of the presence or absence of end provides for regulation of non-game wildlife. Places restric species. Remedial action will conserve and promote conse and their habitats.
B. To Be Considered	None	

Table 3.5
Federal Action-Specific ARARs

	Citation	Description
A. ARARs		
1. Disposal of Solid Waste in the Permanent Repository and closure of the Removal 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 st solid waste. The yard soils disposed in the repository may not exhib therefore, are not hazardous waste. However, these soils may be sol contaminated by mining wastes so all wastes are exempt from defini exemption. Contaminated residential soils will be consolidated from repositories. The disposal of this waste material should be in accord management practices.
2. Clean Water Act	Water Quality Criteria 40 C.F.R. Part 131 Water Quality Standards	Establishes non-enforceable standards to protect aquatic life.
3. Clean Air Act	National Ambient Air Quality Standards/ NESHAPS 42 U.S.C. 74112; 40 C.F.R. 50.6 and 50.12	Emissions standards for particular matter and lead.
4. Hazardous Materials Transportation Act	Hazardous Materials Transportation Regulations 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous materials.
5. NPDES Storm Water Discharge for Permanent Repository.	40 C.F.R. Part 122.26; 33 U.S.C 402(p)	Establishes discharge regulations for storm water. Required manager come into contact with storm water. Also required during constructi
6. Transportation of excavated soils.	DOT Hazardous Material Transportation Regulations, 49 C.F.R. Parts 107, 171-177	Regulates transportation of hazardous wastes.
7. Waters 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 di material or dredged material are examples of activities that may invo Four conditions must be satisfied before dredge and fill is an allowat 1. There must not be a practical alternative. 2. Discharge of dredged or fill material must not cause a violation o applicable toxic effluent standards, jeopardize threatened or endange 3. No discharge shall be permitted that will cause or contribute to si 4. Appropriate steps to minimize adverse effects must be taken. Determine long- and short-term effects on physical, chemical, and bi ecosystem.
B. To Be Considered	None	

Table 3.6
State Location-Specific ARARs

	Citation	Description
A. ARARs		
2. Missouri Wildlife Code	Missouri Department of Natural Resources 3 CSR Sec. 10 – 4.111	Requires a determination of the presence or absence of end provides for regulation of non-game wildlife. Places restri species. Remedial action will conserve and promote conse and their habitats.
B. To Be Considered	None	

TABLE 4 - POTABLE WATER ANALYTICAL RESULTS

Sample Number	Primary MCL												Secondary MCL						
	As	Ba	Be	Cd	Cr	Cu	F	Hg	Pb	Sb	Se	Tl	Ag	Al	F	Fe	Mn	Zn	Ca
	10.0	2000	4.0	5.0	100	1300	4.0	2.0	15	6.0	50.0	2.0	100	50-200	2.0	300	50	5000	
	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg
ZPGPLZ-20001	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	322	49.9J	60 U	45
ZPGPLZ-20002	10 U	200 U	5 U	5 UJ	10 U	59.7	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	221	0.5U	100 U	15 UJ	60 U	6.4
ZPGPLZ-20003	10 U	200 U	5 U	5 UJ	10 U	25 U	1.3	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	276	1.3	100 U	15 UJ	60 U	5 U
ZPGPLZ-20004	10 U	200 U	5 U	5 UJ	10 U	25 U	2.6	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	283	2.6	187	572J	60 U	84.
ZPGPLZ-20005	10 U	200 U	5 U	5 UJ	10 U	25 U	2.8	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	335	2.8	100 U	15 UJ	60 U	5 U
ZPGPLZ-20006	10 U	200 U	5 U	5 UJ	10 U	25 U	1.1	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	252	1.1	100 U	15 UJ	60 U	43.
ZPGPLZ-20007	10 U	200 U	5 U	5 UJ	10 U	25 U	2.5	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	`313	2.5	100 U	23.2J	60 U	34.
ZPGPLZ-20008	10 U	200 U	5 U	5 UJ	10 U	25 U	2	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	252	2	100 U	15 UJ	60 U	30.
ZPGPLZ-20009	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	223	0.5U	100 U	15 UJ	60 U	49.
ZPGPLZ-20010	10 U	200 U	5 U	5 UJ	10 U	49.5	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	247	0.5U	100 U	15 UJ	60 U	58.
ZPGPLZ-20011	10 U	200 U	5 U	5 UJ	10 U	65.6	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	218	0.5U	100 U	15 UJ	130	45.
ZPGPLZ-20012	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	231	0.5U	100 U	15 UJ	60 U	40.
ZPGPLZ-20013	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	202	0.5U	100 U	15 UJ	60 U	27.
ZPGPLZ-20014	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	221	0.5U	100 U	15 UJ	60 U	27.
ZPGPLZ-20015	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	206	0.5U	100 U	15 UJ	60 U	41.
ZPGPLZ-20016	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	203	0.5U	100 U	15 UJ	60 U	38.
ZPGPLZ-20017	10 U	200 U	5 U	5 UJ	10 U	71.3	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	229	0.5U	100 U	15 UJ	60 U	52.
ZPGPLZ-20018	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	232	0.5U	100 U	15 UJ	60 U	5 U
ZPGPLZ-20019	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	279	0.5U	100 U	15 UJ	60 U	33.
ZPGPLZ-20020	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	318	0.5U	100 U	15 UJ	60 U	10.
ZPGPLZ-20021	10 U	200 U	5 U	5 UJ	10 U	25 U	1.2	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	1.2	892	499	60 U	11
ZPGPLZ-20022	10 U	200 U	5 U	5 UJ	10 U	25 U	5.1	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	5.1	100 U	21.0	60 U	25.
ZPGPLZ-20023	10 U	200 U	5 U	5 UJ	10 U	91.8	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	182	60 U	67.
ZPGPLZ-20024	10 U	200 U	5 U	5 UJ	10 U	25 U	6.3	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	6.3	100 U	15 U	60 U	6.6
ZPGPLZ-20025	10 U	200 U	5 U	5 UJ	10 U	25 U	0.62	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.62	4010	174	60 U	71.
ZPGPLZ-20026	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	91.
ZPGPLZ-20027	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	33.
ZPGPLZ-20028	39.8	200 U	5 U	5 UJ	28.8	711	0.5U	0.200U	274	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	34500	28.2	1120	44.
ZPGPLZ-20028*	2.13	10 U	1 U	1 U	2 U	2.24			1 U	2 U	5 U	1 U	1 U				7.8	3.65	
ZPGPLZ-20029	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	2220	397	1960	10
ZPGPLZ-20030	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	48.
ZPGPLZ-20031	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	273	15 U	846	44.

Sample Number	Primary MCL												Secondary MCL						
	As	Ba	Be	Cd	Cr	Cu	F	Hg	Pb	Sb	Se	Tl	Ag	Al	F	Fe	Mn	Zn	C
	10.0	2000	4.0	5.0	100	1300	4.0	2.0	15	6.0	50.0	2.0	100	50-200	2.0	300	50	5000	
	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg
ZPGPLZ-20032	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	47
ZPGPLZ-20033	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	269	15 U	60 U	53
ZPGPLZ-20034	10 U	200 U	5 U	5 UJ	10 U	40.7	1.4	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	1.4	100 U	25.9	649	52
ZPGPLZ-20035	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	50
ZPGPLZ-20036	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	222	15 U	60 U	36
ZPGPLZ-20037	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	172	15 U	60 U	45
ZPGPLZ-20038	10 U	200 U	5 U	5 UJ	10 U	67.3	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	64
ZPGPLZ-20039	10 U	200 U	5 U	5 UJ	10 U	29.3	0.5U	0.200U	38.2	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	316	15 U	60 U	5
ZPGPLZ-20039*	2.16	10 U	1 U	1 U	2 U	2 U			1 U	2 U	5 U	1 U	1 U				1 U	2.36	
ZPGPLZ-20040	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 UJ	35 U	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	40
ZPGPLZ-20041	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 U	35 UJ	25 UJ	10 UJ	200 U	0.5U	134	15 U	60 U	38
ZPGPLZ-20042	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 U	35 UJ	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	38
ZPGPLZ-20043	10 U	200 U	5 U	5 UJ	10 U	25 U	2.4	0.200U	10 U	60 U	35 UJ	25 UJ	10 UJ	200 U	2.4	100 U	15 U	60 U	5
ZPGPLZ-20044	10 U	200 U	5 U	5 UJ	12.4	463	0.5U	0.200U	77.8	60 U	35 UJ	25 UJ	10 UJ	275 U	0.5U	2050	17.6	11500	29
ZPGPLZ-20044*	1 U	10 U	1 U	1 U	2 U	20.4			1 U	2 U	5 U	1 U	1 U				2.18	11.1	
ZPGPLZ-20047	10 U	200 U	5 U	5 UJ	10 U	25 U	0.5U	0.200U	10 U	60 U	35 UJ	25 UJ	10 UJ	200 U	0.5U	100 U	15 U	60 U	51

*Residence resampled on February 20, 2006

** Residence resampled on February 22, 2006

TABLE 5 - Comparison of Metal Concentrations in Unpaved Streets and Alleys, Right-of-Ways, Drainage Ways, and Cru Human Health PRGs for Residential Soil

		Region 9 PRG	Unpaved Streets & Alleys		Public Right-of-Ways		Drainage Ways	
		Residential Soil	Max Value	na/Res. PRG	Max Value	na/Res. PRG	Max. Value	na/Res. P
Aluminum	mg/kg	76,000	3,710	0 of 1	13,700	0 of 21	8,850	0 of 21
Antimony	mg/kg	31	2 U	0 of 1	2 U	0 of 21	2 U	0 of 21
Arsenic	mg/kg	22	16	0 of 1	25	1 of 21	25	1 of 10
Barium	mg/kg	5,400	50	0 of 1	394	0 of 21	114	0 of 21
Beryllium	mg/kg	150	1 U	0 of 1	1	0 of 21	1 U	0 of 21
Cadmium	mg/kg	37	4	0 of 1	16	0 of 21	12	0 of 21
Chromium	mg/kg	100,000	7	0 of 1	17	0 of 21	16	0 of 21
Cobalt	mg/kg	900	43	0 of 1	84	0 of 21	88	0 of 21
Copper	mg/kg	3,100	96	0 of 1	434	0 of 21	344	0 of 21
Iron	mg/kg	23,000	15,800	0 of 1	22,600	0 of 21	23,300	2 of 10
Lead	mg/kg	400	648	1 of 1	2,960	16 of 21	4,010	10 of 1(
Manganese	mg/kg	1,800	1,540	0 of 1	3,270	15 of 21	3,080	6 of 10
Mercury	mg/kg	23	0.02	0 of 1	0.06	0 of 21	0.07	0 of 10
Molybdenum	mg/kg	390	2 U	0 of 1	2 U	0 of 21	2 U	0 of 10
Nickel	mg/kg	1,600	51	0 of 1	84	0 of 21	96	0 of 10
Selenium	mg/kg	390	10 U	0 of 1	10 U	0 of 21	10 U	0 of 10
Silver	mg/kg	390	2 U	0 of 1	2 U	0 of 21	2 U	0 of 10
Thallium*	mg/kg	5.2	10 U	0 of 1	10 U	0 of 21	10 U	0 of 10
Vanadium	mg/kg	78	13	0 of 1	33	0 of 21	24	0 of 10
Zinc	mg/kg	23,000	57	0 of 1	529	0 of 21	559	0 of 10

* Detection limits for all samples exceeded residential soil PRG
All samples shown in Table were analyzed by EPA Region 7 Laboratory
U Analyte not detected; value shown is the detection limit

Table 6. PREFERRED REMEDIAL ALTERNATIVE 2 COST SUMMARY

OU3 - Madison-Wide Residential - Alternative 2 Cost Estimate
Cost Estimate - Excavation, Disposal, Vegetative Cover, Potable Well Corrective Action, Health Education and Institutional Controls

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost
Capital Costs				
Mobilization (1)	1		$50,000	$50,000
Property Access, Contaminant Assessment (1)	300	Properties	$400	$120,000
Sample Property	350	Properties	$700	$245,000
Material Movement (excavation, transport, backfilll, dust suppression)	55,800	yd^3	$63	$3,515,400
Post Cleanup Reports (1)	300	Properties	$100	$30,000
Vegetative Cover (2)	300	Properties	$2,000	$600,000
Lead Stabilization	100	Tons SulfiTech	$225	$22,500
10 yd^3 mixer to mix soil and SulfiTech A/T (rental and labor)	24	months	$1,300	$31,200
Air Monitoring (sample and pump rental costs)	15	Samples	$88	$1,320
Road Evaluation (1yd^2 is 3-inches thick)	20,000	yd^2	$15	$300,000
Potable Well Corrective Action (9)	20	well	$5,000	$100,000
New Repository Development Costs (10)	1		$1,500,000	$1,500,000
DIRECT CAPITAL COST SUBTOTAL				$6,515,420
Bid Contingency (15%)				$977,300
Scope Contingency (10%)				$651,500
TOTAL DIRECT CAPITAL COST				$8,144,220
Permitting and Legal (2%)				$162,900
Construction Services (10%)				$814,400
CONSTRUCTION COST TOTAL				$9,121,520
Engineering Design (3%)				$273,600
NON-RECURRING CAPITAL COST				$9,396,000

OTHER ANNUAL COSTS				
ICs - VICP Implementation and Management	4	year	$60,000	$240,000
Institutional Controls (Annual Health Education)	4	year	$80,000	$320,000
Allowance for Repository Maintenance Cost	4	year	$10,000	$40,000

Present Worth Analysis

Year	Annual Capital Costs	Costs Include:
1	$2,499,000	Annual Capital Costs are assumed to be 25% of the Total Capital Cost.
2	$2,499,000	Annual Capital Costs are assumed to be 25% of the Total Capital Cost.
3	$2,499,000	Annual Capital Costs are assumed to be 25% of the Total Capital Cost.
4	$2,499,000	Annual Capital Costs are assumed to be 25% of the Total Capital Cost.
Total Capital Costs	**$9,996,000**	
Total Present Worth of Capital Costs	**$8,464,641**	

Cost Estimate Component	Capital Cost
TOTAL PRESENT WORTH	**$8,464,641**

Notes:

1 - Information from Feasibility Study for Residential Yard Soil, Omaha Lead Site, Omaha, Nebraska, EPA, 2004

2 - Information from Evaluation of Phosphate Treatment of Residential Properties; Omaha Lead Site, Omaha, Nebraska, Black and Veatch, 2007

3 - A 7.0% discount rate was used to calculate present worth.

4 - The bid contingency for the project was estimated to be 15% of the direct capital cost subtotal.

5 - The scope contingency for the project was estimated to be 10% of the direct capital cost subtotal.

6 - Permitting and legal fees for the project were estimated to be 2% of the total direct cost.

7 - The construction services cost for the project was estimated to be 10% of the total direct cost.

8 - The engineering design cost for the project was estimated to be 3% of the total direct cost.

9 - Assumes worst-case scenario as well replacement in lieu of filtering, treatment, repair or alternate supply

10 - Assumes $30,000 per acre development for 30 acres, engineering and design $350K Development includes clearing, grubbing, road constructions access conrols and +20% cost variance.

ATTACHMENTS

ATTACHMENT 1

MDNR - REMEDY CONCURRENCE LETTER

STATE OF MISSOURI   Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

AUG 14 2014

Ms. Cecilia Tapia, Director
Superfund Division
U.S. EPA, Region VII
11201 Renner Boulevard
Lenexa, KS 66219

Dear Ms. Tapia:

The Missouri Department of Natural Resources' Division of Environmental Quality has reviewed the "Proposed Plan, Operable Unit 3, Madison County Mines Superfund Site, Madison County, Missouri" dated July 2014, as prepared by the U.S. Environmental Protection Agency (EPA), Region VII. The Division generally concurs with the EPA's preferred final remedial action alternative for Operable Unit 3 (OU3, Madwide Residential) to address remaining residential soil contamination in Madison County related to lead and other metals mining activities. However, this concurrence with the final remedy described in the Proposed Plan is granted with the understanding that the final decision on the level of funding for operation and maintenance (O&M) activities including educational outreach and implementation of the Voluntary Institutional Control Program as the site transitions into state funded O&M will be dependent on a reasonable amount of time of EPA funding and oversight of these activities in Remedial Action, and available state funding to continue these activities in O&M. It has been noted that EPA is proceeding with similar remedies in other southeast Missouri counties, which could potentially place the state in a position to be responsible for similar levels of cost in multiple counties. EPA should be aware that large annual expenditures by the state for long-term O&M activities may not be sustainable in the long-term.

It is our understanding that the proposed remedy for the final Record of Decision (ROD) for Madison County Mines Superfund Site OU3 is Alternative 2. We understand that residential properties and high child use areas with at least one quadrant of the property testing greater than 400 ppm lead will have the affected quadrants excavated and replaced with clean soil. Excavation will extend to where soil is less that 400 ppm lead, or a maximum of 12 inches depth. Excavation will occur to a depth of 24 inches in garden areas. A demarcation barrier will be put in place if lead concentration exceeds 1,200 ppm lead at the base of the excavation. Contaminated soil will be disposed of at the Conrad Repository. Remediated properties will be revegetated upon completion of excavation activities. Any remaining properties not previously tested under the interim ROD will be tested as part of the chosen remedy, and remediated as needed.

Health education and outreach activities will continue under the preferred remedy. The Voluntary Institutional Control Program (VICP) will be utilized to provide information to citizens on proper soil handling and disposal practices when conducting excavation projects. The VICP will utilize the DigRite program, and will have staff to do on-site testing with an X-ray fluorescence analyzer if other site sampling information is not available.

Under this remedy, private wells within 1,250 feet of contaminant source areas will be sampled. If found contaminated, a replacement water source and/or appropriate treatment will be provided.

We understand the EPA has identified no currently viable potentially responsible parties for Operable Unit 3. Based on the cost estimates in the Proposed Plan, it is anticipated that the State of Missouri will be expected to pay ten percent (10%) of the actual remedial action costs, and take over O&M on this site after the completion of the second site-wide Five Year Review, but in no case earlier than year four of the remedial action. It is anticipated that the Superfund State Contract currently in place for the interim ROD for OU3 will need to be amended before the EPA fund-lead Remedial Action can begin under the final ROD for OU3.

Thank you for the opportunity to participate in selection of the remedial action for OU3. If additional or unanticipated issues come to light during the public comment period and completion of the ROD, the Department reserves the right to provide additional input that may affect the outcome of the final ROD. If you have any comments or questions, please contact me at (573) 751-0763, or Mr. Evan Kifer of the Department's Hazardous Waste Program, P.O. Box 176, Jefferson City, MO 65102-0176, by telephone at (573) 751-1990, or via e-mail to evan.kifer@dnr.mo.gov.

Sincerely,

DIVISION OF ENVIRONMENTAL QUALITY

Leanne Tippett Mosby
Division Director

LTM:ekj

Attachment 2

BLACK & VEATCH SPECIAL PROJECTS CORP.
MEMORANDUM

BVSPC Project 44701
BVSPC File E.9
April 25, 2007

To: Bob Feild, EPA

From: David Sanders

SUBJECT: Evaluation of Phosphate Treatment of Residential Properties; Omaha Lead Site, Omaha, Nebraska

1.0 Introduction

The Omaha Lead Site (OLS) includes contaminated surface soils (generally between 0 to 6 inches below ground surface (bgs) present at residential properties, child-care facilities, and other residential-type properties in the city of Omaha, Nebraska, which were contaminated as a result of historic air emissions from lead smelting and refining operations. The current OLS Focus Area encompasses approximately 25 square miles, centered in downtown Omaha.

The United States Environmental Protection Agency (EPA) began sampling residential properties and properties used for licensed child-care services in March 1999. The initial 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, the OLS Focus Area was expanded to include the area south of L Street to the Sarpy County line, an area north of Ames Avenue to Redick Avenue, and an area to the west of 45th Street.

Between March 1999 and October 2006, surface soil samples were collected from over 31,000 residential properties. It was estimated in the RI report that approximately 40 percent of the properties within the Focus Area have soils exceeding 400 ppm lead. The December 2004 Interim Record of Decision (ROD) identified response actions that are to be performed prior to issuing the final ROD, including excavation and replacement of contaminated soils at residential properties with surface soil lead concentrations exceeding 800 ppm. EPA currently estimates that approximately 5,000 properties will require soil clean-up based on current residential soil sampling results.

Studies conducted at other Superfund sites contaminated with similar forms of lead have concluded that the application of certain phosphate-based compounds can result in the conversion of lead in surface soils to relatively insoluble minerals with reduced bioavailability. The December 2004 Interim ROD states the following regarding the implementation of a remedy that includes phosphate treatment of residential soils.

> *The EPA is interested in the possible treatment of lead contamination in residential properties that are contaminated at low to moderate levels (less than approximately 800 ppm). Treatability studies conducted by the EPA at other sites indicates that phosphate treatment may be capable of lowering the bioavailability of lead in soil by as much as fifty percent or more, thereby reducing risks resulting from lead exposure. After treatment, lead remains present in the soil, but is transformed into a form that is less toxic. In the less-toxic form, lead concentrations up to approximately 800 ppm may be protective in residential soils.*
>
> *Treatment generally involves stabilizing metals in the soil by adding reagents such as phosphate into the soil to a depth of 6 to 10 inches. For phosphate treatment, it is anticipated that the reagent, in the form of phosphoric acid, would be roto-tilled into the soil, and allowed to transform lead contamination for several days. A neutralizing agent such as lime is then added to the treated soils to raise the pH, and a grass lawn is re-established.*

EPA has requested BVSPC to review previous pilot and bench scale studies that included the use of phosphate treatment and provide an evaluation of the effectiveness and implementability of a remedy that includes phosphate treatment of residential soils at approximately 10,000 residential properties.

2.0 Description of Alternative

The remedial alternative would consist of adding phosphorus in the form of phosphoric acid (PA) along with potassium chloride (KCl) to the residential soils. This combination is believed to react with lead in the soil to form the extremely insoluble chloropyromorphite thus rendering the lead unavailable for leaching. The chemical application rates and the procedures for applying the chemicals to the properties are the same as those used in the lead bioavailability study performed at the Jasper County Superfund Site in Joplin, Missouri (Mosby 2002). The soil would be initially roto-tilled to a depth of about 15 cm. An amount of PA acid equivalent to 5 g Phosphate (P)/kg soil (approximately 18.9 liters of fertilizer grade (85%) PA per 8 square meters) would be applied along with 500 mg KCl/kg of soil. After roto-tilling the soil, another 5 g P/kg of soil would be added and the soil would be roto-tilled a third time. This application rate would require approximately 915 gallons of PA and 335 pounds of KCl to be applied to each property. After a period of between 3 to 10 days, lime would be added to the soil at a rate of 9.1 kg of lime ($Ca(OH)_2$) per 8 square meters. At this application rate, approximately 1,837 pounds of lime would be applied per property and the soil would be roto-tilled to a depth of approximately 10 cm.

3.0 Results of Previous Investigations

The majority of the investigations which bear the most relevance to this project are those that have been conducted on soils from the Jasper County Superfund Site in Joplin, Missouri. Investigations have been conducted at the site since May 1996 (Cornish, 2004). A summary of the salient features of these and other investigations follows.

Casteel, et.al, in 1997 determined relative bioavailability (RBA) after treating the soil using 10 g P as phosphoric acid per kilogram (kg) of soil (hereafter referred to as 1% PA). RBA was measured using *in vivo* testing with young swine. After 60 days the reduction in the RBA of lead in the treated soil compared to the untreated soil was 32 percent.

Yang, et.al, in a 2000 report to the Missouri Department of Natural Resources (MDNR) described the treatment of lead-contaminated soil from the Jasper County, Missouri site using various amounts of PA. Pilot-scale studies were conducted and *in-vitro* testing was performed on the samples to measure lead bioaccessibility. Ninety days following treatment, the reduction of bioaccessible lead in the treated soil ranged from 39 percent to 64 percent

Brown, et. al. (2004) used iron plus triple super phosphate (TSP), compost, TSP, and PA on soils from the Joplin site in both laboratory and field studies. A portion of the soil samples treated in the laboratory was evaluated using *in vivo* testing on weaning rats. A reduction in lead bioavailability of 26 percent was observed in the laboratory samples treated with 1% PA. For field samples that were treated with 1% PA and evaluated using *in vitro* testing only, the percent reduction in bioaccessibility was 25 percent in soils amended to pH 1.5 and 66 percent in soils amended to pH 2.2. The conclusions of the study indicated that it is possible to reduce the bioaccessibility of soil lead, but that evaluating the magnitude of the reduction is not clear-cut. The report indicated that excess P in soil and its potential effect on the eutrophication of surface water remains a concern and that in addition, in cases of co-contamination with arsenic, P addition has been shown to solubilize soil arsenic (Peryea 1991).

The Mosby, et al. report of 2006 was a follow-up of the Mosby 2002 report that described a pilot-scale study at the Joplin site. The study used juvenile swine for the *in vivo* testing. The 2006 report indicates the reduction in RBA using 1% PA after 78 months is 43 percent, a value similar to the value of 38.1 percent determined 18 months after treatment.

A study was conducted under the EPA's Superfund Innovative Technology Evaluation (SITE) program to determine if the available lead in contaminated soil would be less available after treatment with an in situ soil amendment (Barth 2004). Two commercially available soil treatment processes were evaluated for lowering the availability of lead from the soil. Following application of the phosphate amendment, the soils were sampled for 60 months. The long-term trend in bioaccessibility results for both treatments indicated an upward trend in bioaccessibility values in the 5 year period after treatment. The comparison between the treated soils and the control soils indicated that the long-term effectiveness of the treatment process could not be demonstrated.

4.0 Short Term/Long Term Effectiveness

Treatment of residential soils using a phosphate amendment has not been implemented during a full scale remediation project. The bench and pilot scale studies that have been performed have had mixed results, although the previous studies have generally indicated that the bioavailability of lead has not been reduced by 50 percent. However, the results of the studies conducted at other sites may not be applicable to the OLS because of differences in the type of soil and the sources of lead contamination.

Even assuming that the phosphate treatment will reduce the bioavailability of lead in soils by 50 percent, there are other sources of lead that contribute to blood lead levels and other factors that are considered in quantifying risks. Consequently, achieving a 50 percent reduction in the bioavailability of lead in soils using phosphate treatment may not reduce the risks from lead exposure by 50 percent.

During the first 3 to 10 days after the addition of the phosphoric acid, the soil will have a low pH near the surface which may 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 or shrubs 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 was applied to raise the pH of the soil and the property was sodden. 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.

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.

Following application of the phosphoric acid, lime will be added to raise the soil pH to acceptable levels and the property will be sodden. Previous studies are inconclusive as to whether phosphate treatment results in long-term reduction in the RBA of lead in soils. Previous studies indicated that the reduction in RBA will vary over the years and may actually increase after application of the phosphate treatment. Phosphorus concentrations decrease rapidly with depth, and column studies have shown that in 90 days approximately 20% of the added phosphorus leached through 30 cm of soil depth (see Mosby, 2002). Contamination of groundwater is expected to be negligible. Rainfall occurring during treatment of the property would have the potential to increase the phosphorous concentration in the storm water runoff. Erosion control techniques would have to be implemented to prevent soil and chemicals from entering the storm water runoff.

5.0 Implementability of Alternative

The property would be roto-tilled before the chemical addition and again following each of the two applications of the phosphoric acid. Roto-tilling can be a simple and easy procedure; however there is the potential for damage to shrubs, trees, patios, sidewalks, and driveways on the property if the roto-tilling is not performed carefully.

The application of the phosphoric acid treatment on residential properties has not been attempted on a large scale. This treatment alternative uses 85% phosphoric acid which can cause skin irritation and possibly burns, as well as damage to the respiratory system of workers (http://www.hillbrothers.com/msds/pdf/phosphoric-acid.pdf) if not handled properly. It is viscous, making application difficult and it may crystallize in winter.

Assuming that approximately 915 gallons of phosphoric acid would be required to treat each property and that 10,000 yards would require treatment, approximately 9 million gallons of acid would be required over the duration of the remedial action. Off site 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, agreement with the vendor to return the excess acid, or an agreement with the local wastewater treatment facility to dispose of the acid. To reduce the application problems, the acid could be diluted. This, however, produces the risk of a slower reaction of the phosphoric acid with lead and a slight increase in the solubility of chloropyromorphite.

The application of KCl and lime, which are both solids, would be relatively straightforward. Lime; however, is also caustic and appropriate precautions would have to be taken during its application. Lime will be stored in an area separate from the phosphoric acid. Sodding the property is also straightforward.

6.0 Costs

The cost of the phosphoric acid treatment for a 0.25 acre residential property is estimated to be approximately $12,305 per property. The assumptions and the cost estimate are included in Appendix A.

7.0 Community Acceptance

Application of the phosphoric acid to residential properties may not be well received by home owners. Because the acid will pose a risk to young children and small animals until it is neutralized with lime, the home owner may reject this remediation alternative, especially if children or pets live on the property. The addition of a phosphorus source that does not reduce the soil to low pH levels, such as rock phosphate and TSP, would potentially be more appealing to the public, but it has not been demonstrated to achieve an equivalent level of effectiveness. In order to improve public acceptance of any soil treatment option, it is likely that a demonstration project, conducted at an actual residential property, would be required prior to full scale implementation of phosphate treatment.

Public support of any remedial alternative is dependent upon the community's understanding of how a proposed action actually mitigates risk to human health. A treatment alternative for lead-contaminated soils that relies upon a reduction in bioavailability to provide protection would be difficult for some community members to understand and accept. Many community members would be expected to perceive that the remaining presence of lead in the soil presents an unacceptable risk regardless of any change in bioavailability. Without convincing skeptical community members of the long-term effectiveness of soil treatment, public support would be difficult to achieve.

ATSDR has reported that arsenic levels in some residential yards in Omaha currently pose a public health threat. Phosphate treatment has been reported to increase the bioavailability of arsenic (Peryea, 1991). The community would be expected to have serious concerns about phosphate treatment increasing the mobility or bioavailability of arsenic in soil resulting in increased risks due to contaminants that are unrelated to the former Asarco facility and therefore ineligible for Superfund response.

Another element of public acceptance which may prove difficult to achieve is the support of local health departments that perform interventions in community households to reduce lead exposure to lead-poisoned children. Typically, the local health agency will intervene at the residence of a child that is identified with an elevated blood lead level by performing an inspection to identify the most significant sources of lead exposure in the household. Local health workers would be unable to assess the relative risk posed by various sources that a child may be exposed to without understanding the relative bioavailabilities of the each potential source.

Another impediment to achieving public acceptance would be the lack of support for a final remedy that allows soils to remain in place with lead concentrations that are defined to constitute a hazard by other federal programs (Title X under the Toxic Substances Control Act and the Department of Housing and Urban Development define bare soils exceeding 400 ppm as a lead hazard). In some instances, response actions may be recommended or required by local or state lead-hazard control programs for soils which are defined to constitute a hazard, regardless of reduced bioavailability. Treatment of soils in these instances would not affect requirements under other programs to take action due to the elevated lead levels that remain in place.

This type of opposition to proposed phosphate treatment of lead-contaminated soils has been expressed by local health departments in EPA Region 7. Health departments from the City of Joplin, Missouri and Jasper County, Missouri submitted joint a letter to EPA dated September 6, 2006 expressing concerns about a plan to use phosphate treatment to remediate residential yards at the Jasper County, Missouri Superfund site. The concerns raised by the health departments included interpretation of lead data following treatment of yards; cost of the phosphate treatment compared to excavation and removal of the contaminated soil; potential damage to infrastructure such as curbs, sidewalks, and vegetation where the treatment occurs; and the potential for phosphorous discharge in storm water runoff that could impact streams (September 6, 2006 letter from Dan Pekarek, Joplin Health Director).

8.0 Conclusions

The December 2004 Interim ROD for the OLS indicated that the EPA is interested in the possible treatment of lead contamination in residential properties that are contaminated at low to moderate levels (less than approximately 800 ppm). If phosphate treatment were capable of lowering the bioavailability of lead in soil by 50 percent or more, the technology might be appropriate for remediation of properties with lead concentrations of 800 ppm or less. However, if a 50 percent reduction the bioavailability of lead can not be consistently achieved, the technology may not be applicable to residential yards with lead contamination less than 800 mg/kg.

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. Some pilot and bench scale studies have demonstrated that phosphate treatment may reduce the bioavailability of lead to some extent, although studies have been inconclusive. The studies do not indicate that the bioavailability of lead can be consistently reduced by 50 percent or more as discussed in the Interim ROD. In addition, the phosphate treatment may lose its effectiveness over time. If the phosphate treatment does not permanently reduce lead bioavailability, the technology can not be relied upon to provide long-term protection.

The technology has some negative features, such as implementability and public acceptance. During the first 3 to 10 days after the addition of phosphoric acid, the soil will have a low pH near the surface which may pose a risk of irritation or burns to the skin following dermal contact. The phosphoric acid could damage the exterior of the 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 the property during treatment of the yard. The fence would have to remain until the lime was applied and the yard was sodded. 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.

Depending on the method of applying the phosphoric acid, there would be a risk to workers from aerosol spray. Workers would be required to wear protective clothing, including respiratory protection, during the application of the phosphoric acid.

Roto-tilling the property before the chemical addition and again following each of the two applications of the phosphoric acid could damage shrubs, trees, patios, sidewalks, and driveways on the property if not performed carefully

Rainfall occurring during treatment of the property would have the potential to increase the phosphorous concentration in the storm water runoff. Erosion control techniques would have to be implemented to prevent soil and chemicals from entering the storm water runoff.

9.0 References

Barth, E.F., Succop, P.A., and Evans, M.L. (2004) Evaluation of Lead Availability in Amended Soils Monitored over a Long-Term time Period, environmental Monitoring and Assessment 30: 1-14.

J. Cornish, and N. Lewis. Mine Waste Technology Program. Phosphate Stabilization of heavy Metals Contaminated Mine Waste Yard Soils, Joplin, Missouri NPL Site. EPA/600/R-04/090, April 2004.

S.W. Casteel, R.W. Blanchar, and W.J. Brattin. Draft Bioavailability of Lead in Untreated and Phosphorus Treated Soil from the Jasper County site – Joplin, Missouri July 1997, prepared for Missouri Department of natural Resources.

J. Yang, R.W. Blanchar, S. W. Casteel, and D.E. Mosby. Effect of Phosphoric Acid Treatment on Lead Bioavailability in the Contaminated Soil in the Jasper County, Joplin, Missouri. Soil Treatments and Characterization. Final Report Submitted to Missouri Department of natural Resources, July 2000.

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S. Brown, R. Chaney, J. Hallfrisch, J. A. Ryan, and W. R. Berti. In Situ Treatments to Reduce the Phyto- and Bioavailability of Lead, Zinc, and Cadmium. J. Environ. Qual. 33:522, 2004.

D.E. Mosby, S. Casteel, J. Yang, and C.J. Gantzer. Final Report Lead Bioavailability Study Phosphate Treatment of Lead-Contaminated Soils, Joplin, Missouri, Jasper County Superfund Site. Prepared for Missouri Department of natural Resources Hazardous Waste Program, Jefferson City, MO and U.S. Environmental Protection Agency Region VII, Kansas City, KS, December 2006.

F.J. Peryea. Phosphate-Induced Release of Arsenic from Soils contaminated with Lead Arsenate. Soil Sci. Soc. Am. J., 55:1301, 1991.

September 6, 2006 letter from Dan Pekarek, Joplin Health Director, to Mark Doolan, US Environmental Protection Agency.

Appendix A
Cost Estimate

Appendix A
Cost Estimate

Phosphate Treatment of Residential Properties at the Omaha Lead Site, Omaha, Nebraska

Assumptions for Cost Analysis
April 27, 2007

This cost estimate presents the costs to implement a phosphate treatment remedial action at the Omaha Lead Site in Omaha, Nebraska. The estimate contains the cost breakdown of the tasks and procedures required to implement the remedial action.

Following is an outline of the cost estimate assumptions; phosphate treatment procedures; and other considerations that directly and indirectly affect the remediation process and impact the cost estimate:

A. Assumptions:

1. Treatment area of 7,890 square feet (sf) (Property size equivalent to .25 survey acres/property at 10,890 sf minus 3,000 sf for improvements, landscaping, and other areas = 7,890 sf)

2. Contractors for project shall function as follows:

    a. Prime Contractor
    - Mobilization to property
    - Property assessment
    - Property area preparation (prior to treatment process)
    - Install protective barrier/erosion fencing
    - Rototilling #1 (to depth of about 15 cm)
    - Initial Application of Chemicals (Phosphoric Acid and Potassium Chloride)
    - Rototilling #2
    - Application of addt'l 5g Phosphate (P) Kg soil
    - Rototilling #3
    - Lime stabilization of soil / pH adjustment
    - Soil preparation for sod placement (see subcontractor below)
    - Re-install lawn features
    - Remove protective barrier/erosion fencing
    - Demobilization from property

    b. Subcontractor(s)
    - Lawn Service Subcontractor
        - Lay sod (following application of chemical agents and soil preparation for sod placement)
        - Replacement of damaged plantings / shrubs, etc

3. 85% Phosphoric Acid (PA) is applied at rate of 10 U.S. gallons per 86.1113 sf. (37.8 Liters per 8 sq. meters); (note: per *Harcros Chemicals, Inc.*, PA is typically purchased by the pound at a weight of 13-14 lbs of raw acid/gallon; use 13.5 lbs/gal. PA is incorporated into the soil at approx. 6" depth during roto-tilling operations.

   Volume of PA required per property:
   7,890 sf /property x 10 gal / 86.1113 sf = 916.256 gal PA / property

   Weight of PA required per property:
   916.256 gal PA / property x 13.5 lbs / gal = 12,369.45 lbs / property
   (approx. 12,370 lbs / property)

4. Potassium Chloride (KCl) (fertilizer grade) is applied at a rate of 335 lbs / 7,890 sf property (1.66 kilograms per 8 sq. meters). The KCl shall be applied in conjunction with the application of the Phosphoric Acid.

5. Lime is applied at a rate of 1837 lbs / 7,890 sf property (9.1 kilograms per 8 sq. meters). The Lime will be applied and incorporated in the soil by rototilling and grading for drainage, and compaction to 85% Proctor. Lime incorporation occurs after a period between 3 to 10 days following the application of the PA and KCl.

B. *Listing of Phosphate Treatment Procedures:*

Step 1	Property Assessment (e.g., identify buried utility locations)
Step 2	Property preparation (prior to treatment process)
Step 3	Install protective barrier/ erosion controls around property
Step 4	Rototilling #1 of soil
Step 5	Apply Phosphoric Acid chemical
Step 6	Apply Potassium Chloride chemical
Step 7	Rototilling #2 of soil
Step 8	Apply Application of addt'l 5g Phosphate (P) Kg soil
Step 9	Rototilling #3 of soil
Step 10	Incorporate Lime into soil (follows a prescribed 3 to10 day period after Step 8)
Step 11	Fine Grade / compaction of disturbed soil to prepare for sod placement
Step 12	Placement of Sod
Step 13	30 day watering period to establish sod (provide cost allowance to owner)
Step 14	Re-install lawn features
Step 15	Replacement of damaged plantings / shrubs, etc. (note: provide cost allowance)
Step 16	Remove protective barrier/erosion controls

C. Direct-Indirect cost impacts and considerations:

1. All properties are considered to be residential.

2. Costs of chemicals and sod placement are based on delivery to Omaha, NE.

3. The location of buried utilities issues (i.e., cable T.V., sprinkler systems, underground electrical) are a concern. An allowance for locating the utilities has been included in the estimate.

4. Costs associated with pet control issues are not addressed in this estimate.

5. HAZWOPER - OSHA Compliant Training costs are considered requirements for all personnel and included in the analysis.

6. Assumed Daily Log / Journaling tasks for remediation program inherent to all activities.

7. This cost estimates does not provide for allowances where property conditions may exist in which owner has invested substantial resource into lawn care / maintenance, etc.

8. When soil is rototilled, it may bulk in volume approx. 15%, and require re-compaction prior to sod placement. (See Steps 5 through 10 of treatment procedures.)

10. Analysis assumes erosion control barrier will be required in addition to the protective barrier.

11. Analysis does not provide for Testing /Sampling following remediation procedures.

12. A cost allowance is made for areas of properties that may require some re-sodding. For purpose of the cost estimate, the basis is 10% of 10,000 total residential properties requiring 5% sod re-placement.

13. No cost allowance is made for temporary displacement of individuals / pets / livestock, etc., during the remedial process.

14. Prime and Subs will need to mob / demob to each residential property. An allowance for mob / demob of equipment and personnel and documentation procedures is provided in the analysis.

15. Costs do not include oversight by agency personnel.

16. It is assumed contractor personnel shall be required to wear protective clothing during all chemical applications and presence on the property prior to sod placement. Respirators will be required during application of the phosphoric acid.

17. Analysis does not include costs associated with obtaining access to properties, characterization costs, or post-treatment evaluation costs.

18. Costs relating to damage of property features (i.e., sidewalks, drives, ornaments) are not included.

19. A cost allowance for watering the sod for 30 days is provided for in the estimate.

20. Costs associated with limitations and encumbrances to property access are not included.

21. Risks associated with the acidic and caustic nature of applied chemicals are not addressed. Risks may include ecological impacts and associated costs due to stormwater runoff which discharges into streams and air-borne particulates which become in contact with property features (i.e., housing, automobiles, and other property features.)

22. Risks, concerns, and issues which are associated with stormwater runoff discharged onto adjoining properties are not evaluated in this analysis.

23. A 10% contingency is added to the estimated phosphate treatment cost to allow for unforeseen conditions and circumstances relating to remedial operations.

24. Contractor delivery capability of chemicals in residential areas is an issue due to the limited size requirements of delivery vehicles and limited roadway features typically found in residential areas. Associated risks / costs impacts due to delivery of chemicals to a property are not included.

25. Availability and costs of the chemicals are affected by seasonal demands supplies on manufactures from agri-business, or other industries.

26. Due to the extensive gross chemical quantities required for a remediation program of 10,000 residential properties, a controlled storage and staging facility of chemicals will be required for the OLS program. The facility would warehouse and allow for breakdown of delivered products into manageable and effective units. It would be required for the facility to adequately shelter the products from the elements and meet public safety needs. Sufficient personnel and equipment would be required to manage and maintain operations at the storage and staging facility. Although the specific requirements for the facility are not known, an allowance has been included in the analysis.

27. Davis-Bacon wage rates are used in for labor costs.

28. Costs are in current 2007 U.S. dollars (as of April 2007).

D. Following pricing information provided by:
   1. Commodity chemical pricing:

Harcros Chemicals, Inc
Omaha, Nebraska
9000 F. Street
Omaha, NE 68127
Attn: Mr. Don Woolsey
Phone: (402) 331-4525

Note: Commodity chemical pricing from Harcros as of 10 April 2007, and intended only to reflect market conditions as of this date. Product supply and demand affect product price accordingly.

	Cost / Unit of Measure
Phosphoric Acid	**$0.24 / lb**

(Product cost includes delivery to Omaha, NE, and is based on delivery by 45,000 gallon tanker truck. As stated per *Harcros Chemicals, Inc.*, PA is typically purchased based on a weight of 13 to 14 lbs of acid / gallon; use 13.5 lbs/gallon to determine total pounds required per property.

Potassium Chloride (Potash) **<u>$0.19 / lb</u>**
(Fertilizer Grade)
(Product cost includes delivery to Omaha, NE, and is based on 44,000 lb truck delivery of 50 lb bag dry product, on 2000 lb pallets)

Lime **<u>$0.18 / lb</u>**
(Product cost includes delivery to Omaha, NE, and is based on 44,000 lb truck delivery of 50 lb bag dry product, on 2000 lb pallets).

__Harcros Chemicals Inc__ is a major distributor and producer of industrial chemicals. Privately held since a management buy-out in 2001, the Company began business in 1917 as Thompson-Hayward Chemicals, and in 1961 was purchased by North American Philips. In 1981, Harrisons and Crosfield plc purchased the bulk of the business from Philips, subsequently changing the name to Harcros Chemicals Inc.

The core business of Harcros is the distribution of industrial chemicals, with twenty-eight branches in twenty states, including the cities of Omaha, NE., and Kansas City, KS.)

2. Other Pricing:

Protective Barrier (Safety Fence)
Home Depot, Inc.
$17.00 / 50-ft roll = approx. $0.35 per LF

Sod (Lawn Service)
Midwest Landscaping; Omaha, NE (402-339-5151) $.20-$.24 / SF
Interstate Grass Pad: Omaha, NE (402-331-6577) $.27 / SF
Sod City: Omaha, NE (402-331-6577) $.23 / SF

(note: these sod providers are currently supporting present Remediation processes in Omaha, NE

[Use avg......$0.25 / SF installed = $250.00 / MSF installed]

BLACK & VEATCH

DATE: April 27, 2007

CLIENT: Environmental Protection Agency
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site
LOCATION: Omaha, Nebraska

Prepared By: M. Ledbetter / G. Hicks
Checked By: D. Sanders

PROJECT NO. 044701.0121

SHEET 1 OF 10

TOTAL SUMMARY OF ESTIMATED TREATMENT COSTS:

Item	Unit	Total Labor	Total Equip	Total Material	Subcontract	Total Contract
PROJECT COSTS (INCL (incl PT&I and Sales Tax, Prime Overhead, Profit)	LS	$ 2,495	$ 877	$ 5,270	$ 2,433	$ 11,075
SUBTOTALS		$ 2,495	$ 877	$ 5,270		$ 11,075
MATERIAL ESCALATION @	0.00%	x	x	$ -	x	$ -
LABOR / EQUIP ESCALATION @	0.00%	-	-	n/a	x	-
SUBTOTALS		$ 2,495	$ 877	$ 5,270	x	$ 11,075
CONSTRUCTION BOND	1%	—	—	—	x	$ 111
					ESTIMATED TREATMENT COST =	$ 11,186
TREATMENT CONTINGENCY @	10%	—		—		$ 1,119

Total estimated Phosphate Treatment costs for .25 acre Property = $ 12,305

Total estimated Phosphate Treatment costs for 10,000 Properties = $ 123,047,185

BLACK & VEATCH

PROJECT: **Phosphate Treatment of Residential Properties at the Omaha Lead Site**

SUMMARY OF ESTIMATED TREATMENT COSTS (CON'T) SHEET 2 OF 10

1. THIS SUMMARY REFLECTS ESTIMATED TOTAL TREATMENT COSTS IN 2007 DOLLARS.
2. COSTS ARE PRIMARILY DERIVED OR ABSTRACTED FROM " RS MEANS" COST DATA, AND PRICING INFORMATION PROVIDED BY VENDOR / SUPPLIERS.
3. TREATMENT COSTS HAVE BEEN ADJUSTED TO REFLECT "AREA COST FACTOR" IMPACTS BASED ON DAVIS-BACON HEAVY HIGHWAY WAGE RATES AS APPLIED TO THE OMAHA, NE AREA. COSTS INCLUDE BASE RATES AND FRINGES.
4. ESTIMATE PRESUMES CONTRUCTION WILL BE WITH A SELF-PERFORMING PRIME CONTRACTOR AND ONE SUBCONTRACTOR.
5. ESTIMATE ASSUMES PRIME CONTRACTOR AND SUBCONTRACTOR WILL BE "LOCAL" TO OMAHA, NE, AND SHALL HAVE MINIMAL MOB & DEMOB COSTS.
6. THE CONTINGENCY PERCENTAGE ASSIGNED IS BASED ON LEVEL OF UNFORESEEN CONDITIONS IMPACTING REMEDIATION. THE CONTINGENCY ALLOWS FOR UNEXPECTED COSTS IN LABOR, MATERIAL, SITE CONDITION IMPACTS, ETC., WHICH MAY RESULT IN ADDITIONAL COSTS SPECIFIC TO ANY GIVEN PROPERTY. THE CONTINGENCY IS ADDED TO THE ESTIMATED TOTAL TREATMENT COST OF THE PROJECT.

BLACK & VEATCH

DATE: April 27, 2007

CLIENT: Environmental Protection Agency
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site
LOCATION: Omaha, Nebraska

PROJECT NO. 044701.0121

BASIS FOR ESTIMATE
_____ CODE A (No Design Complete)
_____ CODE B (Preliminary Design)
_____ CODE C (Final Design)
__X__ OTHER (Specify)

COST ANALYSIS - PRIME CONTRACTOR SUMMARY

ESTIMATORS: M. LEDBETTER / G. HICKS

SHEET 3 OF 10

PRIME CONTRACTOR SUMMARY	Quantity		Labor Cost		Equipment Cost		Material Cost		PRIME CONTRACTOR TOTAL COSTS	ACCUMULATIVE TOTAL COSTS
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Total Material		
TOTAL BARE COSTS (SEE PRIME / SUB WORKSHEETS)				$ 1,506.90		$ 630.22		$ 3,708.11		
Labor, Equipment & Materials Adjustments due to hazardous site conditions			10%	$ 150.69	10%	$ 63.02	5%	$ 185.41		
Total Bare Costs				$ 1,657.59		$ 693.24		$ 3,893.52		
Payroll Taxes and Insurance (PT&I) ; and Sales Tax (on material only)			19%	$ 314.94	0%	$ -	7%	$ 272.55		
SUBTOTAL				$ 1,972.54		$ 693.24		$ 4,166.08		
TOTAL DIRECT COST				$ 1,972.54		$693.24		$ 4,166.08		
OVERHEAD @			15%	$ 295.88	15%	$103.99	15%	$ 624.91		
SUBTOTAL				$ 2,268.42		$ 797.23		$ 4,790.97		
PROFIT			10%	$ 226.84	10%	$ 79.72	10%	$ 479.10		
SUBTOTAL				$ 2,495.26		$ 876.95		$ 5,270.07	$ 8,642.28	$ 8,642.28
TOTAL SUBCONTRACTOR COSTS									$ 2,211.89	
PRIME CONTRACTOR MARGIN ON SUBS								10%	$ 221.19	
									$ 2,433.08	$ 2,433.08
TOTAL PRIME CONTRACTOR										$ 11,075.36

Notes:
1. Costs shown on these pages of the analysis are reflected as cost to the owner.

2. Costs do not include CONSTRUCTION BOND.

3. Costs within the Prime Contractor Summary do not include any CONTINGENCIES affiliated with the remedial program.

BLACK & VEATCH

DATE: April 27, 2007

CLIENT: Environmental Protection Agency
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site
LOCATION: Omaha, Nebraska

PROJECT NO. 044701.0121
COST ANALYSIS

BASIS FOR ESTIMATE
_____ CODE A (No Design Complete)
_____ CODE B (Preliminary Design)
_____ CODE C (Final Design)
__X__ OTHER (Specify)

ESTIMATORS: M. LEDBETTER / G. HICKS
SHEET 4 OF 10

PRIME CONTRACTOR WORK / TASK ITEM	Quantity		Labor Cost		Equipment Cost		Material Cost				UNIT
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Material Cost	Shipping	Total Material	TOTALS
GENERAL REQUIREMENTS											
Temp Facilities and Controls (mob / demob); incl logging/closeout procedures; (Prime - Contractor allowance)	1	LS	$ 25.00	$ 25.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 25.00
Allow $25 total per Property: $20.00 equip mob + $5.00 logging/closeout procedures = $25.00 per Property											
Specialized Training (HAZWOPER - OSHA Compliant Training) Allow $450 for a one week (40 training session) which trains all personnel for duration of entire abatement program	1	LS	$ 0.633	$ 0.83	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.83
Personnel requiring training are those involved in all preparation and treatment efforts prior to sod placement. Training Costs are distributed over entire 10,000 properties at the Omaha Lead Site project.											
Est. 7 people trained; $450 per wk / 7 people = $64.28 cost per person; assume $64.28 / 10,000 properties = approx. $0.01 course cost / per person / property; labor costs paid during training 40 hrs x (assume 5 persons x $22.75 avg / hr + 2 persons x $22.21 / hr) = $6326.80 div. by 10,000 = $0.633											
labor costs paid during training: 40 x (5 x $15 + 2 x $10.41) = $3832.80 div. by 10,000 = $0.38 / property thus $0.38 + $0.01 = $0.39......use $0.40 / property = Avg. HAZWOPER - OSHA Compliant Training cost per Property											
Controlled Chemical Storage and Staging Facility: Costs associated with a controlled storage and staging facility of chemicals should be incurred for the Omaha Lead Property abatement program. The facility would warehouse and allow for breakdown of delivered products into manageable and effective units. An Estimated amount of $3,000,000 is required for property / facility acquisition, facility operations over estimated 7 year period; and de-commissioning of facility. Thus, $3,000,000 / 10,000 properties = $300 cost impact per property	1	LS	$ 75.00	$ 75.00	$ 75.00	$ 75.00	$ 150.00	$ 150.00	$ -	$ 150.00	$ 300.00
PROPERTY ASSESSMENT											
Prior to remedial procedures and property preparation, evaluate specific needs to prep Property for treatment (incls photos of existing Property conditions prior to construction)	1	MHr	$ 23.05	$ 23.05	$ -	$ -	$ -	$ -	$ -	$ -	$ 23.05
(allow 1 hour avg time frame; 1 laborer = 1 MHr); laborer may also be used in Property Area Prep below											
PROPERTY AREA PREPARATION (prior to treatment process) Following initial assessment temporarily remove / store on-Property any lawn features which will impact an effective treatment process, and to provide protection of such features (allow 4 hours avg time frame, 2 laborers = 8 MHr)	8	MHr	$ 22.21	$ 177.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 177.68
INSTALL PROTECTIVE BARRIER / EROSION CONTROL Install PROTECTIVE BARRIER around perimeter of 25 acre Property Property; allow 400 LF per Property (allow for 2 laborers to install approx. 200 LF per HR at $22.21 ea / hr = $0.222 / LF labor cost Material Costs: 400 LF x 10 properties x $5.00 LF of barrier with EC / (10,000x400) = $0.005; assume $0.01 / LF material / property	400	LF	$ 0.222	$ 88.80	$ -	$ -	$ 0.01	$ 4.00	$ -	$ 4.00	$ 92.80
ROTOTILLING #1 Rototilling of property prior to application chemicals; (Crew RT-1)	7.890	MSF	$ 0.40	$ 3.10	$ 0.43	$ 3.40					$ 6.50

Phosphate Treatment of Residential Properties at the Omaha Lead Site

COST ANALYSIS

PRIME CONTRACTOR WORK / TASK ITEM	Quantity		Labor Cost		Equipment Cost		Material Cost				UNIT TOTALS
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Material Cost	Shipping	Total Material	
APPLICATION OF CHEMICALS (Phosphoric Acid and Potassium Chloride)											
Spray application of Phosphoric Acid onto soil (1 complete Property = 7890 SF = 7.890 MSF); (Crew SPR-1) Allow 916 256 gal / Property application rate, allow for (2) technicians ; 1 for application; 1 for monitoring tank truck	12370	LBS	$ 0.0220	$ 272.14	$ 0.0250	$ 309.25	$ 0.24	$ 2,968.80	$ -	$ 2,968.80	$ 3,550.19
assume 6 hrs total at application rate of 350 oz. per hour; technicians hourly rate assumed at $15.00 / hr thus for 6 hr treatment process assume: (6 hrs x 2 techs x $22.75/hr) / 12370 lbs = $0.022 / lb labor Use equipment cost approx. equivalent to labor cost, assume $0.025 / lb equip (Note. material costs per Harcros Chemicals, Inc., Omaha, NE)											
Application of Potassium Chloride (Potash) onto soil (1 complete Property = 7890 SF) (includes both initial after rotodiling #1 and secondary application after rototilling #2)	335	LBS	$ 0.136	$ 45.56	$ 0.025	$ 8.38	$ 0.19	$ 63.65	$ -	$ 63.65	$ 117.59
allow 335 LBS / Property application rate, allow for (1) technician ; Material costs per Harcros Chemicals, Inc.											
assume 2 hrs total at application rate of 167.5 CF per hour; technicians hourly rate assumed at $22.75 / hr thus for 2 hr treatment process assume: (2 hrs x 1 tech x $22.75 / hr) / 335 LBS = $0.136 / LB											
Safety wear / protective gear (i.e., TYVEK outwear, gloves, protective face masks)	3	SETS	$ -	$ -	$ -	$ -	$ 50.00	$ 150.00	$ -	$ 150.00	$ 150.00
(incl 1 pr coveralls $4.88; pr gloves @ $1.99, 1 ea respirator @ $25.00 ; protective eyewear @ $5.00 = 1 set Total cost of 1 set = $46.88.....assume $50.00 per person x 3 laborers = $150.00 / Property (pricing per Northern Safety Company)											
Decontamination Shower (ALLOW $700 / UNIT FOR 10 UNITS; pricing per Northern Safety Company) ($700 units X 10 ea div. 10,000 Propertys = $0.70 per Property costs . . ..assume $1.00; allow 1 MHr at $15 for setup / Property; assume (1) technician required for 1 hr to set up unit	1	Ea	$ 22.75	$ 22.75	$ -	$ -	$1.00	$ 1.00	$ -	$ 1.00	$ 23.75
ROTOTILLING #2 **(follows Phosphoric Acid and Potassium Chloride application- see above)** Rototilling of property prior to application chemicals ; (Crew RT-1)	7.890	MSF	$ 0.40	$ 3.19	$ 0.43	$ 3.40					$ 6.59
ROTOTILLING #3 (follows 5g Phosphate (P) Kg soil application- see above) Rototilling of property prior to application chemicals ; (Crew RT-1)	7.890	MSF	$ 0.40	$ 3.19	$ 0.43	$ 3.40					$ 6.59
LIME STABILIZATION OF SOIL / PH ADJUSTMENT Application of Lime onto soil (1 complete Property Property = 7890 SF = 876.67 SY)	1837	LBS	$ 0.15	$ 275.55	$ 0.015	$ 27.56	$ 0.18	$ 330.66	$ -	$ 330.66	$ 633.77
includes Rototilling #4, grade for drainage, and compaction to 85% Procter, allow 1837 LBS / Property application ; allow 2.0954 LBS / SY application rate, allow for (1) technician assume application rate of 150 SY per hr per hour; 876.67 / 150 SY per hour = 5.84 hrs technicians hourly rate assumed at $22.75 / hr thus : (5.84 hrs x 2 techs x $22.75/hr) / 1837 LBS = $0.1446... assume $0.15 / LB labor Material costs per Harcros Chemicals Inc.											
Costs of Safety wear / protective gear (i.e., Tyvek outwear, gloves, protective face masks) incl above incl above in "APPLICATION OF CHEMICALS"	x	x	x	x	x	x	x	x	x	x	x
Allowance for protection / relocation / repair of impacted buried / underground utilities assume 4 MHrs per Property x $22.75 for each Property = $80.00 labor assume $25 avg equip. cost per each Property assume $40 material cost avg per each Property.	1	LS	$ 91.00	$ 91.00	$ 25.00	$ 25.00	$ 40.00	$ 40.00	$ -	$ 40.00	$ 156.00
SOIL PREPARATION FOR SOD PLACEMENT (also see Sod Lawn Service Subcontractor) Costs of compaction of disturbed tilled soil included in "LIME SOIL STABILIZATION" above	x	x	x	x	x	x	x	x	x	x	x
Finish Grading / Fine grading of lawn / treatment area to prepare for sod placement (see Crew FG-1 costs)	7890	SF	$ 0.03	$ 222.63	$ 0.02	$ 174.65	$ -	$ -	$ -	$ -	$ 397.38

Phosphate Treatment of Residential Properties at the Omaha Lead Site

COST ANALYSIS

PRIME CONTRACTOR WORK / TASK ITEM	Quantity No. Units	Quantity Unit Meas	Labor Cost Per Unit	Labor Cost Total Labor	Equipment Cost Per Unit	Equipment Cost Total Equip	Material Cost Per Unit	Material Cost Material Cost	Material Cost Shipping	Material Cost Total Material	UNIT TOTALS
REINSTALL LAWN FEATURES Following initial assessment temporarily remove / store on-Property any lawn features which will impact an effective treatment process, and to provide protection of such features (allow 2 hours avg time frame with 2 laborers at $22.21 / hr per laborer = 4 MH)	4	MH	$ 22 21	$ 88 84	$ -	$ -	$ -	$ -	$ -	$ -	$ 88 84
REMOVE PROTECTIVE BARRIER Install PROTECTIVE BARRIER around perimeter of .25 acre Property Property; allow 400 LF per Property (allow for 2 laborers to install approx. 200 LF per HR at $22.21 / hr = $0 222 / LF labor cost NO material costs incl	400	LF	$ 0 222	$ 88 80	$ -	$ -	$ -	$ -	$ -	$ -	$ 88 80
DEMOBILIZATION FROM PROPERTY (See "General Requirements" above)	x	x	x	x	x	x	x	x	x	x	x
				$ [illegible]		$ [illegible]				$ [illegible]	$ [illegible]

Notes:
1. Costs shown on page 4 and page 5 of the analysis are reflected as "direct" costs to the Prime Contractor.

2. Costs shown on are developed for a single Property.

BLACK & VEATCH

DATE: April 27, 2007

CLIENT: Environmental Protection Agency
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site
LOCATION: Omaha, Nebraska

PROJECT NO. 044701.0121

BASIS FOR ESTIMATE
________ CODE A (No Design Complete)
________ CODE B (Preliminary Design)
________ CODE C (Final Design)
___X___ OTHER (Specify)

COST ANALYSIS

ESTIMATORS: M. LEDBETTER / G. HICKS
SHEET 7 OF 10

LAWN SERVICE SUBCONTRACTOR SUMMARY	Quantity		Labor Cost		Equipment Cost		Material Cost		SUBCONTRACTOR
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Total Material	TOTAL COSTS
TOTAL BARE COSTS (See SUBCONTRACTOR WORKSHEET)									
Direct costs for Lawn Service Subcontractor (see sheet 8 of 8)				$ 51.97		$ 0.30		$ 107.59	
Labor, Equipment & Materials Adjustments due to hazardous site conditions			10%	$ 5.20	10%	$ 0.03	5%	$ 5.38	
Total Bare Costs				$ 57.17		$ 0.33		$ 112.97	
Payroll Taxes and Insurance (PT&I); and Sales Tax (on material only)			19%	$ 10.88	0%	$ -	7%	$ 7.91	
SUBTOTAL "A" (Replacement of damaged plantings with watering only)				$ 68.03		$ 0.33		$ 120.88	
TOTAL DIRECT COST				$ 68.03		$0.33		$ 120.88	
OVERHEAD @			15%	$ 10.20	15%	$0.05	15%	$ 18.13	
SUBTOTAL				$ 78.24		$ 0.37		$ 139.01	
PROFIT			10%	$ 7.82	10%	$ 0.04	10%	$ 13.90	
SUBTOTAL "B" (with markup Subtotal "A" above)				$ 86.06		$ 0.41		$ 152.92	$ 239.39
SUBTOTAL "C" (Sod Placement assume incl markups)				$ 394.50		$59.18		$ 1,518.83	$ 1,972.50

TOTAL LAWN SERVICE SUBCONTRACTOR PER SITE = $ 2,211.89

BLACK & VEATCH

DATE: April 27, 2007

CLIENT: Environmental Protection Agency
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site
LOCATION: Omaha, Nebraska

PROJECT NO. 044701.0121

BASIS FOR ESTIMATE
_____ CODE A (No Design Complete)
_____ CODE B (Preliminary Design)
_____ CODE C (Final Design)
__X__ OTHER

COST ANALYSIS

ESTIMATORS: M. LEDBETTER / G. HICKS
SHEET 8 OF 10

LAWN SERVICE SUBCONTRACTOR TASK ITEM	Quantity		Labor Cost		Equipment Cost		Material Cost				UNIT TOTALS
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Material Cost	Shipping	Total Material	
LAWN SERVICE											
A. Lay Sod											
(see below for costs of laying sod)											
Allowance for cost of watering by owner to establish sod for a 1 month period (allow $50.00 / month)	1	LS					$ 50.00	$ 50.00	$ -	$ 50.00	$ 50.00
B. Replacement of damaged plantings / shrubs, etc.											
Allowance for replacement of damaged plantings / shrubs, etc. (Costs assumed average per each of 10,000 properties)	1	LS	$ 50.00	$ 50.00	$ -	$ -	$ 50.00	$ 50.00	$ -	$ 50.00	$ 100.00
C. Allowance for Re-sod (followup to initial sod placement)											
Based on total project estimate of 10,000 residential sites, assume 10% of Properties require 5% sod re-placement thus 7890 SF Treatment area per Yd x 10,000 x 10% x 5% = 394500 SF re-placement 394500 SF / 78,900,000 SF proj total = .005 % .005 x 7890 / 1000 SF = .03945 MSF allowance per Properties site for sod re-placement	0.03945	MSF	$ 50.00	$ 1.97	$ 7.50	$ 0.30	$ 192.50	$ 7.59	$ -	$ 7.59	$ 9.86
				$ 51.97		$ 0.30				$ 107.59	$ 159.86

LAWN SERVICE SUBCONTRACTOR TASK ITEM	Quantity		Labor Cost		Equipment Cost		Material Cost				UNIT TOTALS
	No. Units	Unit Meas	Per Unit	Total Labor	Per Unit	Total Equip	Per Unit	Material Cost	Shipping	Total Material	
LAWN SERVICE											
D. Lay Sod (following the applications of chemical treatments to Properties)											
Lay new sod in lawn areas disturbed by treatment process (assume level ground, over 8 MSF) (per current pricing data from Omaha area sod projects, use approx. $0.25 per SF as avg. price installed	7.890	MSF	$ 50.00	$ 394.50	$ 7.50	$ 59.18	$ 192.50	$ 1,518.83	$ -	$ 1,518.83	$ 1,972.50
(note: pricing shown is considered a subcontracted price, assume markups included)											
SUBTOTAL "C" (Sod Placement ; assume incl markups)				$ 394.50		$ 59.18				$ 1,518.83	$ 1,972.50

Notes:
1. Costs shown on page 7 of the analysis are reflected as "direct" costs to the Subcontractor.
2. Costs shown on are developed for a single Properties location.
3. Costs for laying sod are based on installed pricing data from current contractors in Omaha area involved in the present remedial program.
4. MSF = 1000 Square Feet

BLACK & VEATCH — DATE: April 27, 2007

CLIENT: Environmental Protection Agency — Prepared / M. Ledbetter / G. Hicks
PROJECT: Phosphate Treatment of Residential Properties at the Omaha Lead Site — Checked / D. Sanders
LOCATION: Omaha, Nebraska

PROJECT NO. 044701.0121

CREW COSTS:

		Base Hr Rate	Fringes	Harzardous	TOTAL
1	General Laborer	$14.86	$6.35	$1.00	$22.21
2	Supervisor	$15.50	$6.55	$1.00	$23.05
3	Chemical Technician	$15.25	$6.50	$1.00	$22.75
4	Power Equip Oper	$14.99	$6.75	$1.00	$22.74

Topsoil Removal Crew (Crew TS-1)

nr.	Item	LABOR 2007 Davis-Bacon Hr. Rate (Incl Fringes)	EQUIP 2004 MEANS Daily	EQUIP 2007 (esc. by 1.15) Daily	EQUIP 2007 (esc. by 1.15) HR
1	Power Equip Oper	$22.74			
0.5	Labor (at $21.21 / hr)	$11.11			
1	Dozer, 80 hp		$300.20	$345.23	
		$33.85		$345.23	$43.15

Productivity: 200 CY per 8 hr day — 25 CY per hr

Hourly cost per UOM: CY — [illegible] — [illegible]

Rototilling Crew (Crew RT-1)

nr.	Item	LABOR 2007 Davis-Bacon Hr. Rate (Incl Fringes)	EQUIP 2004 MEANS Daily	EQUIP 2007 (esc. by 1.15) Daily	EQUIP 2007 (esc. by 1.15) HR
1	Power Equip Oper	$22.74			
1	Backhoe Ldr w/ attachment		$168.40	$193.66	
		$22.74		$193.66	$24.21

Productivity: 450 MSF per 8 hr day — 56.25 MSF per hr

Hourly cost per UOM: MSF — [illegible] — [illegible]

CREW COSTS (con't):

Chem Spray Application Crew (Crew SPR-1)

hr.	Item	LABOR 2007 Davis-Bacon Hr. Rate (incl Fringes)	EQUIP 2004 MEANS Daily	EQUIP 2007 (esc. by 1.15) Daily	EQUIP 2007 (esc. by 1.15) HR
2	Chemical Technician	$45.50			
		$45.50		$0.00	$0.00

Allow 918.256 gal / Property application rate; allow for (2) technicians ; 1 for application; 1 for monitoring tank truck
assume 6 hrs total at application rate of 350 oz. per hour

Productivity: [illegible] GAL per 8 hr day 152.7 MSF per hr

Hourly cost per UOM: MSF [illegible] $0.00
SF $0.00000 $0.00000

Finish Grading / Fine grading of lawn / treatment area to prepare for sod placement (Crew FG-1)

hr.	Item	LABOR 2007 Davis-Bacon Hr. Rate (incl Fringes)	EQUIP 2004 MEANS Daily	EQUIP 2007 (esc. by 1.15) Daily	EQUIP 2007 (esc. by 1.15) HR
1	Power Equip Oper	$22.74			
0.5	Labor (at $21.21 / hr)	$11.11			
1	Tractor w/ rake attachments		$185.00	$212.75	
		$33.85		$212.75	$26.59

Productivity: 9600 SF per 8 hr day 1200 SF per hr

Hourly cost per UOM: MSF $0.03 $0.02

MADISON COUNTY VOLUNTARY INSTITUTIONAL CONTROLS MANUAL **Policy Manual**

SUBJECT: Introduction	PART: Introduction
	SECTION: 0.1
REFERENCES	EFFECTIVE:
	Revisions: October 2013

Madison County Voluntary Institutional Controls Manual

Developed by The Grindstaff Partnership, LLC
in partnership with
the Citizens of
Madison County Missouri

MADISON COUNTY VOLUNTARY INSTITUTIONAL CONTROLS MANUAL **Policy Manual**

SUBJECT: Credits	PART: Introduction
	SECTION: 0.2
REFERENCES	EFFECTIVE:
	Revisions: October 2013

CREDITS

The Madison County Voluntary Institutional Controls Plan is unique from all other institutional controls plans which focus on lead contamination. Its unique quality is its voluntary nature. Like other lead contamination control plans, Madison County's plan outlines specific controls based on United States Environmental Protection Agency (EPA), Missouri Department of Natural Resourses (DNR) and Missouri Department of Health and Senior Services (DHSS) regulations/policies, and these controls are further expressed in individual "best practices" regarding excavation, hauling and disposal activities. However, unlike other lead contamination plans, the Madison County plan provides education as one of its primary institutional controls.

This manual was created with the assistance of the following entities:

The Madison County Commission in the State of Missouri
The Madison County Health Department
The Madison County Voluntary Institutional Control Plan Coalition consisting of residents of Madison County Missouri
The Missouri Department of Health and Senior Services
The Missouri Department of Natural Resources
The United States Environmental Protection Agency
The Grindstaff Partnership, LLC

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the authors and do not necessarily represent the official views of EPA or the DHSS.

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SUBJECT: Living With Lead	PART: Administrative Framework
	SECTION: 1.1
REFERENCES	EFFECTIVE: October 1, 2012
	Revisions: October 2013

LIVING WITH LEAD

As residents of Madison County, Missouri, we understand that lead is a part of our lives. We know that because of the unique geological qualities of our land, lead can be found both on the surface and under the ground. We also know that 300 years of mining and processing in and among our communities has impacted our land, our water, and our lives.

Living in Madison County requires living with lead. We have built our communities from the wealth of lead. We have grown generations of our families from the abundance of lead. We have created a part of our culture and history from the existence of lead. To live in Madison County is to live with lead. We see the lead and we see the impact of lead on our lives, both the benefits and the challenges.

However, we see what surrounds the lead as well. In Madison County, we live within the St. Francois Mountains and the streams and rivers flowing out of the mountains. We live with farming of livestock, grain, and produce in our fertile fields and valleys. We live in rural communities that value the individual, the family, the community, our beliefs, our education, and our children. We understand the necessity for cooperation and collaboration as a part of our rural foundation of survival.

We also value as a rural foundation, a hearty sense of independence. Historical records illustrate that from the very beginning of our land's inclusion in this country, our ancestors asserted their independent attitudes regarding issues such as property development and ownership of mineral rights. Just as we recognize the importance of independence in the formation of our nation, we recognize the important role it plays in the day to day life of our county's residents. After all, we realize that what works for our county may not work for others, and what works for other counties, may not work for ours.

SUBJECT: Living With Lead	PART: Administrative Framework
	SECTION: 1.1
REFERENCES	EFFECTIVE: October 1, 2012
	Revisions: October 2013

Living in Madison County has afforded us both the benefits and challenges associated with lead. As with generations past, we want to live and work around lead in safe, healthy, efficient, and profitable ways. While we continue to listen to our elder's stories, educate ourselves with legitimately researched information, and gain wisdom from our generations of experience, we find new ways to live around lead. Just as our families who worked the mines of the 20th Century did not use the exact same knowledge, techniques and tools from the one-hundred years before, we, in turn, will not live and work with lead and its by-products using the exact same knowledge, techniques, and tools we had in the 20th Century.

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SUBJECT: Our Challenge and Response	PART: Administrative Framework
	SECTION: 1.2
REFERENCES	EFFECTIVE:
	Revisions: October 2013

OUR CHALLENGE & RESPONSE

Madison County's geography, geology, history, and culture is unique in some ways to any other county in the nation; thus, we have created a unique way to respond to some of our current concerns and questions regarding our life with lead. Because of the amount of lead on and in our land, our county has been listed on the United States Environmental Protection Agency's (EPAs) National Priorities List of contaminated sites. We have worked with the State of Missouri and the Federal Government to educate ourselves and others about health, safety, and environmental concerns. We have allowed the Department of Natural Resources (DNR) and the EPA on our land to perform soil and water tests and to clean up residential areas containing higher percentages of lead than are considered protective of human health.

Now, as we look toward our historical and economical future independent from the lead companies of the past, we want to live on and work with our land in ways that keep additional lead contamination to a minimum. To this end, we have formed a Madison County Voluntary Institutional Controls Plan (VICP). All communities named on the National Priorities List will create some kind of plan for contamination management, but our VICP is unique as it is the only plan in the nation that allows for partnership and engagement in a voluntary way.

Our VICP allows us to educate ourselves with the latest science and health information and work with one another as the need arises instead of telling one another what we have to do because a law says so. As science evolves and as our needs evolve, we can figure out for ourselves the land management practices that work best over a number of years and modify our methods of management through the VICP. Lastly, our VICP will work through partnership within our community, encouraging the kind of cooperation and collaboration our rural tradition values without discouraging the independent attitude our residents have thrived on from the beginning of our county's history.

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SUBJECT: **Overview of Madison County Lead History and VICP**	PART: Administrative Framework SECTION: 1.3
REFERENCES	EFFECTIVE: October 1, 2012 Revisions: January 2014

OVERVIEW OF MADISON COUNTY LEAD HISTORY & VICP

Lead History Leading to Superfund Site

Much of the land known as Madison County was part of southeastern Missouri called "The Old Lead Belt". One of the oldest lead mines west of the Mississippi, Mine LaMotte, sat on the northern end of the county. During the 20th Century, "The Lead Belt" was the site of the largest lead mining operations in the world. The processing and smelting of lead in Madison County left 13 identified major areas of mine waste (chat and slime). The mine waste contains elevated levels of lead and other heavy metals which we now know pose a threat to human health and the environment. The mine waste contaminated soil, sediment, surface water, and groundwater, both on the waste property and elsewhere, as it was transported by both natural and human modes.

Remediation Efforts and Management of Remediation

The superfund law (CERCLA) was enacted in 1980. This law gave the U.S. Environmental Protection Agency (EPA) the authority to find contaminated areas around the United States and clean them up, using funds from whatever parties

Appendix 3 – Madison County Mines OU3 Revised SSC Cost Estimate

Prior SSC Cost Ceiling Estimate from 2014 Final ROD $24,440,000

OU3 Obligations to Date	$25,187,092
ER Residential Contract Option Year 1 (FY19)	$4,200,000
ER Residential Contract Option Year 2 (FY20)	$4,100,000
START Technical Support Services through 2020	$800,000
MDHHS Cooperative Agreement VICP V97757701 through 2020	$100,000
MDHHS Cooperative Agreement Health Education V97757601 through 2020	$200,000
MCHD Cooperative Agreement Residential Sampling Assistance V97750001 through 2020	$200,000
Total	**$34,787,092**