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EVALUATION OF REMEDIAL ALTERNATIVES REPORT

FORMER EAGLEPICHER SMELTER SITE
GALENA, KANSAS

PREPARED FOR:

EP CUSTODIAL TRUSTEE

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CEC Project 061-825

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1.0 PURPOSE

The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, calls for cleanup of hazardous substances under CERCLA to undergo a screening process using proscribed evaluation criteria followed by a critical review by the Lead Agency and provision for a period of public review and comment. Public comments are then considered and addressed as necessary and a Record of Decision (ROD) issued by the Lead Agency that documents their selection process and final selection of a remedial alternative. The Lead Agency for this project is the Kansas Department of Health and Environment (KDHE), which will develop a draft Corrective Action Document (CAD), the state version of a Record of Decision (ROD). Once public comments have been considered through a 30-day public comment period, KDHE will issue a Final CAD with the Secretary's Declaration of a Selected Remedial Action.

This Evaluation of Remedial Alternatives Report has been prepared to meet the substantive requirements of the NCP and provide documentation of the consideration and screening of various remedial alternatives for the former EaglePicher Smelter Site in Galena, Kansas.

2.0 ADMINISTRATIVE BACKGROUND

On April 11, 2005, EaglePicher Holdings, Inc. declared bankruptcy under Chapter 11 of Title 11 of the United States Code. The bankruptcy settlement established an EP Custodial Trust (Trust) and Custodial Trustee (Trustee) pursuant to the July 31, 2006 Custodial Trust Agreement. Settlement Agreements were subsequently established that defined the role of the Trustee and the plans for remediation of the various Trust sites, including the Galena, KS site. Civil & Environmental Consultants, Inc. (CEC) was contracted by the Trustee to provide engineering support to implement remediation at all of the Trust sites. The United States Environmental Protection Agency (EPA) and the Kansas Department of Health and the Environment (KDHE) were both signatories to the Kansas Settlement Agreement, with KDHE designated as the Lead Agency for the sites in Kansas. The Galena, KS Trust fund was established with a finite sum of monies and letters of credit established in an escrow account. As of this date, the Galena, KS Trust account has available funding for the EaglePicher Smelter site in Galena, Kansas that totals approximately $5.2 million.

The Settlement Agreement created as part of the Custodial Trust Agreement stated that "anticipated site cleanup activities may include, but are not limited to the following:

- Surveying, Clearing, Grubbing, Dust Control, and installation of Erosion Control measures.
- Closure of all located and unclosed deep wells in accordance with applicable law.
- Placement or movement of materials within an approximately 68 acre area (which includes a portion of Short Creek and the former smelter site) that exhibit constituent concentrations exceeding risk-based cleanup objectives within an onsite fill (consolidation) area, estimated to be 5 to 15 acres size, but in any event as may be required to contain materials that exceed KDHE risk-based cleanup standards for lead, zinc and other metals. The fill area, which is anticipated to generally be positioned at

the west side of the site and outside of the flood plain of Short Creek, will be completed with a composite soil cover and appropriate slopes to limit erosion.

- The soil cover will consist of a composite geotextile with bentonite (e.g., Bento-Mat) covered with an adequate soil cover to support vegetation with appropriate grasses.
- Removal of sediments from approximately 2,000 feet of Short Creek and placement of those sediments within the onsite fill area.
- Placement of a vegetated buffer along approximately 2,000 feet of the south bank of Short Creek.
- Placement of erosion control for approximately 2,000 feet of Short Creek (e.g.,. stream bank armament, riprap).
- Site surface drainage and diversion.
- Regrading non-covered areas.
- Soil cover maintenance, including re-seeding and fertilizing as needed to maintain an adequate vegetative cover.
- Placement of an environmental use control to limit current and future use of the property to industrial uses.

The entire acreage belonging to EaglePicher Holdings, Inc., was not available during negotiation of the Kansas Settlement Agreement. Additional acreage owned by EaglePicher Holdings, Inc. was later disclosed to the Trustee and KDHE. These properties are included in the evaluation of the remedial cleanup alternatives proposed for the site.

The Custodial Trustee shall establish a mechanism acceptable to the Lead Agency to provide long term care of the Galena Site. It is anticipated that such mechanism will consist of the entry, following KDHE approval of the Corrective Action Design and Corrective Action, into a long term care agreement with an environmental use control agreement filed under the appropriate State of Kansas program."

3.0 SITE DESCRIPTION

The former EaglePicher smelter site in Galena, Kansas is comprised of ±148 acres of land northeast of the town of Galena. Approximately 138 acres of the total 148 acres of the Trust property is currently vacant. The property is further subdivided into the Smelter Plant Area and five outparcels labeled Outparcel A through E (Figure 1). The Smelter Plant Area is ±48.8 acres in size and is bounded by Short Creek to the north and Clark Street to the south. For purposes of site characterization, CEC further divided the Smelter Plant Area into two sub-areas, one inside a fenced area (approximately 10 acres) and another outside the fence (approximately 39 acres). The fenced area includes all the remaining office and production buildings at the Smelter Plant Area. The 10 acres of land inside the existing fence at the site are currently occupied by a tenant that stores equipment and supplies both outside and inside the buildings. The area outside of the fence includes a historic slag dump, a former Acid Plant, and a former enriched ore stockpile known as the Finished Product Storage Area. Future use of the entire site is envisioned to remain the same or similar in nature (i.e., light industrial).

Outparcel A consists of approximately 40 acres and is located northeast of the Smelter Plant Area on the northeastern portion of the property. Outparcel B consists of approximately 5 acres and is located north of the Smelter Plant Area on the north-central portion of the property. Outparcel C consists of approximately 12 acres and is located south of the Smelter Plant Area and old U.S. Highway 66 on the south-central portion of the property. Outparcel D consists of approximately 26 acres and is located north to northwest of the Smelter Plant Area on the northwestern portion of the property. Outparcel E consists of approximately 23 acres and is located south of the Smelter Plant Area and old U.S. Highway 66 on the southwestern portion of the property. Outparcel E is comprised of multiple residential lots and paper streets known collectively as the Brinkerhoff Addition. The Trust owns the residential lots that total 16 acres, but does not own the paper streets that separate the lots that total the remaining 7 acres.

Exhibit B of the Settlement Agreement defined a specifically-known area requiring remediation of ±68 acres, which includes the Smelter Plant Area (±48.8 acres), portions of Outparcel D (±17 acres north of Short Creek and south of the abandoned St. Louis and San Francisco Railroad grade to the north), and portions of Outparcel B (±2.5 acres south of Short Creek and contiguous to the Smelter Plant Area). For the purposes of this report, CEC refers to the area requiring remediation as the Area of Concern (AOC).

4.0 PREVIOUS INVESTIGATIONS

Investigations of the site have been completed by both KDHE and CEC. Following are the primary documents associated with the investigation of the site:

- *Integrated Removal Site Evaluation/Preliminary Assessment Report, KDHE, 2007*
- *Extent of Contamination Investigation, Former EaglePicher Smelter, Galena, Kansas, CEC, October 2008*
- *KDHE response letter RE: Extent of Contamination Report, Former EaglePicher Smelter Site; Galena, Kansas, January 30, 2009*
- *Final Supplemental Extent of Contamination Investigation Report, Former EaglePicher Smelter, Galena, Kansas, CEC, July 26, 2010*
- *KDHE response letter RE: Supplemental Extent of Contamination Investigation Report, Former EaglePicher Smelter Site; Galena, Kansas, July, 1, 2010*

The investigations indicated that the site soils contain levels of metals, primarily lead, arsenic and mercury, which exceed KDHE RSK standards for both residential and non-residential scenarios. These RSK standards were exceeded for metals in soil and waste over a majority of the AOC and in various areas within the outparcels. TCLP testing of the materials showed that a majority of the samples exceeded the regulatory limit for lead. However, this material is considered to be Bevill-exempted waste in accordance with the Bevill exclusion (October, 1980, RCRA amendment Section 3001 (b)(3)(A)(ii). This rule specifically excludes "solid waste from the extraction, beneficiation and processing of ores and minerals" from regulation as hazardous waste under Subtitle C of RCRA (40 CFR 261.4(b)(7)). Contaminated materials extend to depths of up to 15 feet below grade in some areas within the AOC. Lead speciation testing was performed on samples from all the outparcels in order to attempt to distinguish contamination impacts from historical smelter operations versus known regional geographic mining impacts. Lead speciation testing of the soil indicated that sources of lead in Outparcels A, C, D and E

were different than those sources of lead identified from smelter operations located within the AOC.

Two former settling ponds containing high levels of mercury were identified and delineated within the AOC. These ponds are located on the eastern half of the AOC near the processed lead ore area. Additionally, there are various piles of waste located in several outparcels that tested for mercury. CEC collected 12 samples of material from the settling ponds for TCLP mercury testing. None of the twelve samples contained leachable mercury in excess of the regulatory limits. One co-located sample collected and analyzed by KDHE displayed leachable mercury levels above the regulatory limit.

Concentrations of metals including lead, arsenic, cadmium, zinc and mercury exceeded Threshold Effect Concentrations (TEC) in sediment in Short Creek. Lead, arsenic, cadmium and zinc contamination occurs in Short Creek both up and down gradient of the site as a result of the regional mining impacts in the area.

5.0 REMEDIAL ACTION OBJECTIVES

The primary Constituents of Concern (COC) at the site are lead, arsenic and mercury found in smelter waste, site soils and stream sediments. The Remedial Action Objectives (RAO) for the site include:

- Human Health: prevent human exposure through direct-contact with and/or ingestion to contaminated soil and smelter waste with levels of COCs in excess of KDHE RSK non-residential standards
- Ecological: prevent additional adverse impact from contaminated soil, sediment and smelter waste to aquatic life, individuals of a threatened or endangered species and other ecological receptors
- Contaminant Transport: prevent migration of soil, sediments and smelter waste that contain COCs in excess of applicable standards that could result in greater environmental degradation of surface water, sediment, soils and the adjacent environment

The Settlement Agreement states materials exceeding KDHE RSK standards for lead, zinc and other metals shall be contained, thereby meeting the RAOs..

Given the widespread nature and extent of impacts, it is not possible to implement a remedial strategy which achieves cleanup of the Site for unrestricted property use within the available funding of the Trust for the AOC and the additional outparcels. Therefore, KDHE and the Trustee have prioritized the remedial activities that need to be implemented within the financial limitations of the Trust.

The letter from KDHE dated July 1, 2010 recommended that CEC consider the following limited removal actions to address the areas outside the primary AOC, based on results of the lead speciation sampling that demonstrated areas of lead contamination that were likely not associated

with the smelter plant operations, but more indicative of contamination associated with historical mining activities in the area. KDHE's recommendations included the following:

- Outparcel A: Removal of surface waste piles, documented buried waste areas and limited mercury-contaminated wastes;
- Outparcel B: Address all of outparcel B;
- Outparcel C: To be addressed under the Superfund program, since contaminated material appears to be similar to regional contamination resulting from lead and zinc mining, based on the lead speciation sampling results;
- Outparcel D: Address the portion of Outparcel D within the original AOC and limited areas of mercury-contaminated soils outside of the AOC; and
- Outparcel E: Removal of limited areas of mercury-contaminated soils and the remainder of the outparcel to be addressed under the Superfund program, since contaminated material appears to be similar to regional contamination resulting from lead and zinc mining, based on the lead speciation sampling results.

6.0 INITIAL CLEANUP ALTERNATIVES SCREENING

Initial cleanup alternative screening was performed to narrow the range of possible alternatives to those that meet the financial criteria related to the finite sum of monies available to the Trust for completion of the project. This amount is on the order of $5.2 million. The initial screening evaluated four initial remedial alternatives for the Site:

- No Action
- Offsite disposal as non-hazardous waste
- In-situ soil stabilization
- Onsite consolidation and covering

6.1 NO ACTION

The No Action alternative will be further evaluated in order to provide a baseline to which the other alternatives can be compared.

6.2 OFFSITE DISPOSAL AS NON-HAZARDOUS WASTE

The current estimated volume of material exceeding KDHE industrial RSK standards that are planned for excavation, consolidation and covering is about 175,000 cubic yards. Assuming a unit weight of 2 tons per cubic yard, this translates to an estimated total tonnage of 350,000 tons. If the impacted materials were disposed off-site as a non-hazardous waste, at an assumed cost of $50/ton for excavation, transport and disposal of all the impacted material, the cost would be approximately $17.5 million, exceeding the budgetary constraints of the EP Custodial Trust. If mercury contamination identified in the settling ponds and various waste piles located around the Site exceeds TCLP, this material would have to be treated as a hazardous waste at an assumed cost of $150/ton for excavation, transport and disposal.

6.3 IN-SITU SOIL STABILIZATION

According to the USEPA Remediation Technologies Screening Matrix and Reference Guide, Version 4.0, the cost for in-situ shallow soil stabilization is between $40 and $60 per cubic yard and deep soil stabilization is estimated at between $150 and $250 per cubic yard. The estimated cost for treatment of 175,000 cubic yards of material would be approximately $10.5 million for shallow soil stabilization and $43.8 million for deep soil stabilization, far exceeding the budgetary constraints of the Trust.

6.4 ONSITE CONSOLIDATION AND COVERING

The Settlement Agreement contemplates consolidation and covering of contaminated materials onsite. In November 2008, CEC prepared a preliminary assessment of several conceptual cleanup alternatives within the framework of the Settlement Agreement and provided that information to KDHE in a document entitled "Conceptual Feasibility Study, Remediation of Contaminated Soil, Former EaglePicher Smelter Site, Galena, Kansas". The purpose of the assessment was to preliminarily evaluate several potential remedial options in order to compare estimated implementation costs to the total funds available to the Trust to address the site. The preliminary options evaluated were:

- Option 1 – Smelter Plant Area and Outparcels A, B, C, D, and E;
- Option 2 – Smelter Plant Area and Outparcels B, C, D, and E;
- Option 3 – Smelter Plant Area and Outparcels B, C, and D;
- Option 4 – Smelter Plant Area and Outparcels B and D;
- Option 5 – Smelter Plant Area, 2.5 Acres of Outparcel B and 17.2 Acres of Outparcel D; and
- Option 6 – Smelter Plant Area, 2.5 Acres of Outparcel B, 17.2 Acres of Outparcel D, and Mercury-Contaminated Soil Disposed as Hazardous Waste.

The preliminary assessment indicated costs to implement the described options ranged from $4.9 to $8.3 million. A majority of these estimates exceeded the total funding available to the Trust, leaving only Options 4 and 5 as possible alternatives given the financial limitations of the Trust funding.

7.0 CLEANUP ALTERNATIVES

The following sections describe the cleanup alternatives that passed the screening described in Section 6.0 above. The alternative for consolidation and covering has been further refined to provide a comparison of cost-benefit to addressing all the contaminated materials in a 2000 feet stretch Short Creek flowing through the Site versus addressing only the materials in Short Creek that contain elevated levels of mercury, and consolidating and covering those materials above the high-water mark of Short Creek.

7.1 ALTERNATIVE 1 - NO ACTION

Alternative 1 – No Action would entail no remedial actions to mitigate existing contamination, but would include minimal engineering and institutional controls such as a fence around the AOC with "No Trespassing" signs to exclude trespassers. An Environmental Use Control (EUC) would be implemented and recorded with the deed to the property that would, at a minimum, restrict the entire site to industrial usage, prohibit the use of site groundwater and provide for long-term maintenance of the Site. In addition, a soil management plan and worker health and safety plan would be implemented to address future subsurface work at the Site.

7.2 ALTERNATIVE 2 - ONSITE CONSOLIDATION AND COVERING INCLUDING STREAM SEDIMENTS

Alternative 2 – Onsite Consolidation and Covering using an engineered cap including stream sediments is generally reflective of the Settlement Agreement guidelines and input from KDHE per their letter of July 1, 2010. This alternative consists of the excavation of impacted materials from the extreme west end of the AOC, the north side of the Smelter Plant Area between the fence and Short Creek, and the east end of the AOC where enriched ore was stored. Confirmatory sampling of the excavated areas will be performed to demonstrate adequate removal of impacted materials. In addition, the two mercury settling ponds in the northeast

corner of the AOC will be partially removed and then covered. Removal of the mercury contaminated soil in the settling ponds will be limited to the depth of the local water table. Total removal of the material will not be performed since the total depth of the ponds extends below the level of the local water table resulting in unstable excavation conditions and large volumes of mercury-impacted water which would be cost prohibitive given the financial limitations of the Trust. In addition, some proportion of the mercury-impacted materials, both solid and liquid, may be characteristically hazardous and require off-site disposal at considerable additional cost. This may also include mercury identified as characteristically hazardous located in Outparcels A and E. Sediments in the wetted perimeter of Short Creek and its floodplain within the AOC that exceed Probable Effects Concentrations (PECs) will also be excavated. The rail road trestles on the north side of Short Creek will be addressed. Also, limited volumes of specifically-identified waste materials and piles located on Outparcels A and E will be excavated. The excavated materials will be transported to an onsite consolidation area located at the west end of the AOC over what is now an area of slag disposal. The material will be consolidated and covered with a geomembrane liner and geosynthetic drainage layer followed by 2-feet of soil and revegetated with shallow-rooted grass species. The covered area will be fenced upon completion.

Upland areas, defined as those areas above the high-water mark of Short Creek, where material will be removed will be directly revegetated without importing cover soil using appropriate soil amendments and native seed mixtures similar in nature to the approach taken at the nearby Galena Subsite OU-5 reclamation area located to the west of the site. The south bank of Short Creek where sediments will be removed will be addressed by installation of earth-stabilizing materials such as turf reinforcement mat and vegetation to reduce erosion and provide stream bank stabilization. Slope stabilization consisting of riprap and armament will be placed on the north slope of the consolidation cell to prevent erosion during high water events. The area inside the fence where commercial activities are currently being conducted will be covered with a minimum of six inches of clean, compacted gravel to prevent exposure to existing soils.

The scope and cost estimate are predicated on acceptance of the following:

(1) Equipment and vehicles used will be off-road only, using non-taxed, dyed diesel fuel. No costs are included for vehicle licensing, bonding, highway crossing permits, or restoration or traffic control.

(2) The maximum extent of vertical excavation will not extend below the shallow groundwater table, clean soil, or bedrock, whichever is encountered first.

(3) Only surficial soil removal will be performed on the north side of Short Creek in addition to specifically-identified "hot-spots" and the rail road trestles. Buried waste identified in Ouparcel A will also be addressed.

(4) Contaminated materials located below the water table will not be removed but will be covered with earth-stabilizing materials and soil and revegetated to prevent direct contact and future erosion.

(5) Contaminated soil within the existing fence of the Smelter Plant Area will be covered in place using a minimum of six inches of clean, compacted gravel.

(6) Remediated upland areas (above the existing high-water mark) outside of the existing fence of the Smelter Plant Area will be directly revegetated similar to revegetation efforts currently being implemented for the Operable Unit 5 located at the Cherokee County Superfund Site.

(7) All excavated material will be placed in the onsite consolidation area unless the material containing mercury has been determined to be characteristically hazardous through TCLP testing.

(8) XRF field readings will determine when the cleanup standards are achieved, with a minimum of 5% of the field samples analyzed by fixed-lab methods to verify the quality of the XRF data.

(9) All work will be performed in Level D personal protective equipment with active dust suppression.

(10) A geosynthetic composite material with a drainage layer will be used in construction of the onsite consolidation area in place of a Bentomat layer as stipulated in the Settlement Agreement.

(11) No investigation or mitigation of the mine shaft identified on Outparcel D will be performed.

(12) Groundwater production wells are presumed to have been previously abandoned by others.

(13) Contaminated sediment in 3,000 linear feet of Short Creek abutting the Smelter Plant Area will be excavated and placed in the onsite consolidation area. The maximum vertical extent of excavation will be limited to 1 foot or bedrock, whichever is shallower and no confirmatory sampling will be performed.

(14) No clean bed-load will be placed in Short Creek after removal of 1 foot of sediment.

(15) No concrete building foundations, floor slabs or other remnants will be removed.

(16) The consolidation area will be fenced upon completion with a locking gate and signage.

(17) Long-term maintenance will consist of EUC inspection requirements, erosion and sedimentation prevention and controls, including filling of ruts, rills and animal burrows, revegetation as necessary, periodic cutting of grass, and bank stabilization maintenance over a 30-year period. Long-term maintenance activities will commence upon completion of the consolidation cell.

7.3 ALTERNATIVE 3 - ONSITE CONSOLIDATION AND COVERING WITH LIMITED SPOT-REMOVAL OF MERCURY-IMPACTED SEDIMENTS

Alternative 3 – Onsite Consolidation and Covering using an engineered cap with Limited Spot-Removal of Mercury-Impacted Sediments is generally reflective of the Settlement Agreement guidelines and input from KDHE per their letter of July 1, 2010 with the exception that only materials that contain mercury at concentrations in excess of the Probable Effects Concentrations (PECs) are proposed to be removed from below the existing high-water mark of Short Creek. This alternative consists of the excavation of impacted materials from the extreme west end of

the AOC, the north side of the Smelter Plant Area between the fence and Short Creek, and the east end of the AOC where enriched ore was stored. Confirmatory sampling of the excavated areas will be performed to demonstrate adequate removal of impacted materials. In addition, the two mercury settling ponds in the northeast corner of the AOC will be partially removed and then covered. Removal of the mercury contaminated soil in the settling ponds will be limited to the depth of the local water table. Total removal of the material will not be performed since the total depth of the ponds extends below the level of the local water table resulting in unstable excavation conditions and large volumes of mercury-impacted water which would be cost prohibitive given the financial limitations of the Trust. In addition, some proportion of the mercury-impacted materials, both solid and liquid, may be characteristically hazardous and require off-site disposal at considerable additional costs. Only sediments in Short Creek below its high-water mark within the AOC that exceed Probable Effects Concentrations (PECs) for mercury will be excavated. The rail road trestles on the north side of Short Creek will be addressed. Also, limited volumes of specifically-identified waste materials and piles located on Outparcels A and E will be excavated. The excavated materials will be transported to an onsite consolidation area located at the west end of the AOC over what is now an area of slag disposal. The material will be consolidated and covered with a geomembrane liner and geosynthetic drainage layer followed by 2-feet of soil and revegetated with shallow-rooted grass species. The covered area will be fenced upon completion.

Upland areas, defined as those areas above the high-water mark of Short Creek, where material was removed will be directly revegetated without importing cover soil using appropriate soil amendments and native seed mixtures similar in nature to the approach taken at the nearby Galena Subsite OU-5 reclamation area west of the site. Slope stabilization consisting of riprap and armament will be placed on the north slope of the consolidation cell to prevent erosion during high water events. The area inside the fence where commercial activities are currently being conducted will be covered with a minimum of six inches of clean, compacted gravel to prevent exposure to existing soils.

Based on sediment characterization data, limited spot-removal of mercury-impacted sediments would be targeted in areas where mercury was detected above the PECs in the case of submerged sediments, and above KDHE non-residential RSK standards where the sediments are between the low flow channel and high-flow bank. The rationale for spot removal of mercury-impacted sediments and not full restoration of Short Creek is based on the fact that mercury contamination is directly related to operations from the smelter and that lead associated contamination cannot be completely separated from other contamination from regional lead issues.

Mercury contamination in the low base flow area of the stream will be addressed through Geomorphic Sediment Removal (i.e., picking up the larger sediment and stockpiling on site, removing the fine contaminated sediment, replacing as appropriate and putting back the larger sediment, revegetate as appropriate). The material will be segregated by manual means or by the use of screening equipment or other appropriate means as determined by the contractor. If insufficient material is present from within the stream channel or the remaining material is not suitable, then imported material with similar physical characteristics (i.e., particle size), such as crushed limestone, will be substituted. Major modification to the stream channel would not be part of this remedy due to the financial limitations of the Trust.

Mercury contaminated surface sediments between the low base flow area and the high flow bank will be removed, but excavation will not extend below the water table. Submerged sediments present in Short Creek (low flow channel) that are above the PEC standard for mercury will be removed. Confirmatory samples will be analyzed to determine that sufficient removal of contaminated sediment has been performed. After sufficient material has been removed, the excavation area will be covered with an equivalent thickness of clean gravel or the area regraded with surrounding existing materials to eliminate an abrupt depression where the material was removed.

The scope and cost estimate are predicated on acceptance of the following:

(1) Equipment and vehicles used will be off-road only, using non-taxed, dyed diesel fuel. No costs are included for vehicle licensing, bonding, highway crossing permits, or restoration or traffic control.

(2) The maximum extent of vertical excavation will not extend below the shallow groundwater table, clean soil, or bedrock, whichever is encountered first.

(3) Soil removal on the north side of Short Creek will be limited to specifically-identified "hot-spots" and the rail road trestles. Buried waste identified in Outparcel A will also be addressed.

(4) Only sediments below the high-water mark of Short Creek that contain mercury at concentrations above PECs will be excavated

(5) Contaminated materials located below the water table will not be removed but will be covered with earth-stabilizing materials and soil and revegetated to prevent direct contact and future erosion.

(6) Contaminated soil within the existing fence of the Smelter Plant Area will be covered in place using a minimum of six inches of clean, compacted gravel.

(7) Remediated upland areas (above the high-water mark) outside of the existing fence of the Smelter Plant Area will be directly revegetated similar to revegetation efforts currently being implemented for OU-5 located at the Cherokee County Superfund Site.

(8) All excavated material will be placed in the onsite consolidation area unless the material containing mercury has been determined to be characteristically hazardous through TCLP testing.

(9) XRF field readings will determine when the cleanup standards are achieved, with a minimum of 5% of the field samples analyzed by fixed-lab methods to verify the quality of the XRF data.

(10) All work will be performed in Level D personal protective equipment with active dust suppression.

(11) A geosynthetic composite material with a drainage layer will be used in construction of the onsite consolidation area in place of a Bentomat layer as stipulated in the Settlement Agreement.

(12) No investigation or mitigation of the mine shaft identified on Outparcel D will be performed.

(13) Groundwater production wells are presumed to have been previously abandoned by others.

(14) No concrete building foundations, floor slabs or other remnants will be removed.

(15) The consolidation area will be fenced upon completion with a locking gate and signage.

(16) Long-term maintenance will consist of EUC inspection requirements, erosion and sedimentation prevention and controls, including filling of ruts, rills and animal burrows, revegetation as necessary, periodic cutting of grass, and bank stabilization maintenance over a 30-year period. Long-term maintenance activities will commence upon completion of the consolidation cell.

8.0 EVALUATION OF CONCEPTUAL CLEANUP ALTERNATIVES

The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, is the federal government's blueprint for responding to both oil spills and hazardous substance releases. Section 400.430(e)(9)(iii) of the NCP provides nine criteria for evaluation of remedial alternatives. The analysis of alternatives under review shall reflect the scope and complexity of site problems and alternatives being evaluated and consider the relative significance of the factors within each criteria. KDHE, the lead agency, uses this same criteria. The nine evaluation criteria are as follows:

(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 through treatment
(5) Short-term effectiveness
(6) Implementability
(7) Cost
(8) State acceptance
(9) Community acceptance

8.1 ALTERNATIVE 1 – NO ACTION

Implementation of Alternative 1 – The No Action alternative is not viable for several reasons. The No Action alternative is not protective of human health and the environment since it has been well documented that contaminant levels at the site exceed relevant KDHE cleanup criteria. A No Action alternative will not mitigate future potential exposure to site contaminants by local receptors and continued physical migration of contaminated materials through erosion and windblown transport of particulates and dust will occur, thus there is no long-term effectiveness or permanence. There are no implementability or cost issues associated with the No Action

alternative. Acceptance of the No Action alternative by the state or the community is not likely. The No Action Alternative does not comply with the Settlement Agreement which stipulates that the Trustee will implement remediation at the site as described in Section 2.0 above, thereby eliminating the No Action alternative from further consideration.

8.2 ALTERNATIVE 2 – ONSITE CONSOLIDATION AND COVERING INCLUDING STREAM SEDIMENTS

Compliance with the nine evaluation criteria provided in the NCP for Alternative 2 – Onsite Consolidation and Covering Including Stream Sediments is described below.

(1) Overall Protection of Human Health and the Environment: Removal, consolidation and covering of impacted soils and sediment will provide protection of human health and the environment by mitigating direct exposure to these materials and the continued migration caused by erosion and wind transport.

(2) Compliance with ARARs: Chemical-specific ARAR's will be met by demonstrating that remaining site soils meet KDHE non-residential RSK standards. Location-specific ARAR's will be met since there are no identified threatened or endangered species at the site location and the site is not historically or archeologically significant. The consolidation cell will be constructed above the 100-year floodplain elevation for Short Creek. Action-specific ARAR's will be met by designing and constructing the capped area in accordance with appropriate engineering practices.

(3) Long-Term Effectiveness and Permanence: An engineered designed cap over a consolidation cell is a proven method to address contaminated soil and waste. The cover construction will incorporate a geomembrane liner and geosynthetic drainage layer and engineered grading and revegetation to minimize infiltration of precipitation and subsequent leaching of contaminants. Residual risk remaining from small amounts of upland materials that are not incorporated into the consolidation cell will be minimized

by installation and maintenance of erosion and sedimentation controls and establishment of permanent native vegetation. The north side of the consolidation cell will include an armament to protect the cell from high surface water flow events. EUCs will also be enacted that will limit future site usage and provide for long-term maintenance obligations. A fence with a locking gate and signage will be erected to prevent trespassers from entering the covered area. Areas along Short Creek will be stabilized with appropriate erosion-control materials and engineering means and revegetated.

(4) Reduction of Toxicity, Mobility, or Volume Through Treatment: Actual treatment of impacted materials will not be performed as part of the cleanup plan, but consolidating contamination and covering with an engineered designed cap will minimize mobility of contaminants.

(5) Short-Term Effectiveness: Exposure to site contaminants by site workers and nearby residents would be mitigated during construction through the use of dust suppression techniques such as roadway watering and enclosed equipment cabs. The possibility of flash flooding of Short Creek poses a significant risk of erosion and transport of newly-exposed, fine-grained sediment that is otherwise currently stable. The north side of the consolidation cell will include an armament to protect the cell from high surface water flow events.

(6) Implementability: Excavation, consolidation and capping of impacted materials does not pose significant technical or administrative difficulties. Routine engineering principles will be applied and findings of previous site characterizations will be used. Preference will be given to local construction firms that have had experience working on similar projects. Monetary resources are limited to only the amount of funds available to the Trust. Flash flooding of Short Creek poses a potential risk associated with the construction for reasons mentioned above. Permits will need to be obtained for work within the Short Creek floodplain.

(7) Cost: The cost of the project is limited by the funds available to the Trust. Engineering estimates of the cost to implement this alternative range from $4.1 to $5.1 million. Engineer's estimates of the construction costs are provided below:

Task	Description	Low Cost		High Cost
I	Mobilization and Site Preparation	$200,000	to	$250,000
II	Site Excavation and Remediation	$1,000,000	to	$1,500,000
III	Smelter Area Cover and Remediation	$250,000	to	$300,000
IV	Short Creek Dredging and Remediation (3,000 ft)	$180,000	to	$200,000
V	Disposal Cell Construction and Operation	$1,500,000	to	$1,700,000
VI	Support (Engineering, Bidding, CQA and Project Management)	$600,000	to	$750,000
	SUBTOTAL	$3,730,000	to	$4,700,000
	10% CONTINGENCY	$373,000		$470,000
	TOTAL	$4,103,000	to	$5,170,000

Assuming a yearly long-term maintenance cost of $4300 per year for the covered area, the Net Present Value (NPV) for a sinking fund would be about $75,000, assuming an annual rate of return of 4%. If contractor estimates for the work meet or exceed available funding, tradeoffs may need to be made between the extent of the cleanup efforts and the actual cost in order to realize the most cost-efficient cleanup possible.

(8) State Acceptance: State acceptance will be sought based on KDHE review and comment on this Evaluation of Cleanup Alternatives Report.

(9) Community Acceptance: Community acceptance will be sought through the mandatory public review and comment process.

8.3 ALTERNATIVE 3 – ONSITE CONSOLIDATION AND COVERING WITH LIMITED SPOT-REMOVAL OF MERCURY-IMPACTED SEDIMENTS

Compliance with the nine evaluation criteria provided in the NCP for Alternative 3 – Onsite Consolidation and Covering with Limited Spot-Removal of Mercury-Impacted Sediments is described below.

(1) Overall Protection of Human Health and the Environment: Removal, consolidation and covering of impacted soils will be provide protection of human health and the environment by mitigating direct exposure to these materials and the continued migration caused by erosion and wind transport.

(2) Compliance with ARARs: Chemical-specific ARAR's will be met by demonstrating that remaining site soils meet KDHE nonresidential RSK standards. Location-specific ARAR's will be met since there are no identified threatened or endangered species at the site location and the site is not historically or archeologically significant. The consolidation cell will be constructed above the 100-year floodplain elevation for Short Creek. Action-specific ARAR's will be met by designing and constructing the covered area in accordance with appropriate engineering practices. Sediment ARAR's will be met for mercury. The removal of mercury-impacted sediments is justified since the mercury contamination is associated solely with the historical operations as the smelter while lead contamination is regional in nature due to historical mining activities.

(3) Long -Term Effectiveness and Permanence: An engineered designed cap over a consolidation cell is a proven method to address contaminated soil and waste. The cover construction will incorporate a geomembrane liner and geosynthetic drainage layer and engineered grading and revegetation to minimize infiltration of precipitation and subsequent leaching of contaminants. Residual risk remaining from small amounts upland materials that are not incorporated into the consolidation cell will be minimized

by installation and maintenance of erosion and sedimentation controls and establishment of permanent native vegetation. The north side of the consolidation cell will include an armament to protect the cell from high surface water flow events. EUCs will also be enacted that will limit future site usage and provide for long-term maintenance obligations. A fence with locking gate and signage will be erected to prevent trespassers from entering the covered area.

(4) Reduction of Toxicity, Mobility, or Volume Through Treatment: Actual treatment of impacted materials will not be performed as part of the cleanup plan but consolidating contamination and covering with an engineered designed cap will minimize mobility of contaminants.

(5) Short-Term Effectiveness: Exposure to site contaminants by site workers and nearby residents would be mitigated during construction through the use of dust suppression techniques such as roadway watering and enclosed equipment cabs. The possibility of flash flooding of Short Creek poses a significant risk of erosion and transport of newly-exposed fine-grained sediment that is otherwise currently stable. The north side of the consolidation cell will include an armament to protect the cell from high surface water flow events.

(6) Implementability: Excavation, consolidation and capping of impacted materials does not pose significant technical or administrative difficulties. Routine engineering principals will be applied and findings of previous site characterizations will be used. Preference will be given to local construction firms that have had experience working on similar projects. Monetary resources are limited to only the amount of funds available to the Trust. Flash flooding of Short Creek poses a potential risk associated with the construction for reasons mentioned above.

(7) Cost: The cost of the project is limited by the funds available to the Trust. Engineering estimates of the cost to implement this alternative range from $3.91 to $4.95 million. Engineer's estimates of the construction costs are provided below:

Task	Description	Low Cost		High Cost
I	Mobilization and Site Preparation	$200,000	to	$250,000
II	Site Excavation and Remediation	$1,000,000	to	$1,500,000
III	Smelter Area Cover and Remediation	$250,000	to	$300,000
IV	Disposal Cell Construction and Operation	$1,500,000	to	$1,700,000
V	Support (Engineering, Bidding, CQA and Project Management)	$600,000	to	$750,000
	SUBTOTAL	$3,550,000	to	$4,500,000
	10% CONTINGENCY	$355,000		$450,000
	TOTAL	$3,905,000	to	$4,950,000

Assuming a yearly long-term maintenance cost of $4,300 per year for the covered area, the Net Present Value (NPV) for a sinking fund would be about $75,000, assuming an annual rate of return of 4%. If contractor estimates for the work meet or exceed available funding, tradeoffs may need to be made between the extent of the cleanup efforts and the actual cost in order to realize the most cost-efficient cleanup possible.

(8) State Acceptance: State acceptance will be sought based on KDHE review and comment on this Evaluation of Cleanup Alternatives Report.

(9) Community Acceptance: Community acceptance will be sought through the mandatory public review and comment process.

9.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the relative expected performance of each alternative with respect to the same evaluation criteria described in Section 6.0 above.

(1) Overall Protection of Human Health and the Environment: Alternative 1 provides minimal protection of human health and the environment through institutional and engineering controls. Alternatives 2 and 3 are equally as protective for the upland areas of the Site since the approach is the same – excavation, consolidation and covering with an engineered designed cap. Alternative 2, which includes removal of more sediment (containing lead, cadmium, arsenic and zinc) from Short Creek, may be more protective than Alternative 3 (spot-removal of mercury impacted sediment) from a direct exposure standpoint by virtue of removal of more contamination from the Site.. However, it is predicted that significant removal of the sediment will cause exacerbated stream sediment erosion since the established vegetative cover will be removed and the flow regime changed by lowering the floodplain grade and stream bottom elevation. This could cause enhanced erosion and downstream migration of fine-grained sediment that is currently stable that becomes exposed by the remedial efforts. The fine-grained sediment is believed to contain the highest levels of contaminants.

(2) Compliance with ARARs: Alternative 1 does not comply with chemical-specific ARAR's because contaminants remain in place. Alternative 2 meets chemical-specific ARARs for metals through excavation, consolidation and covering. Alternative 3 complies with sediment ARARs for mercury since existing mercury-contaminated sediment will be removed.

(3) Long-Term Effectiveness and Permanence: Alternative 1 is not an effective long-term remedy for the site since there is only limited effectiveness in preventing exposure through the use of engineering and institutional controls. Excavation, consolidation and

covering will provide adequate long-term effectiveness through the use of sound engineering principals and routine maintenance. Alternative 3 changes the risk of exposure to existing mercury-contaminated sediments compared to current conditions. Alternative 2 may reduce sediment exposure risk near the site, but consequently may enhance erosion and downstream transport of newly-exposed remaining sediments and destabilize existing stream flow regimes.

With respect to Alternative 2, during actual construction or the interim between construction and establishment of permanent vegetative cover (3 years or more) flash flooding of Short Creek, estimated to be on the order of 13,000 cfs for a 100-yr/24-hr storm, could cause significant erosion of newly-exposed fine-grained material from the wetted perimeter of Short Creek and the newly-exposed floodplain areas that are currently relatively stable and vegetated. Also, Short Creek currently shows signs of significant stream bank instability in a lateral direction as evidenced by the braided channel and meander scars. Disturbance of the current flow regime by removal of sediment could cause further instability and increase lateral meandering of the channel.

KDHE (1980) found that "the creek is almost totally devoid of aquatic life with the exception of dense growths of a trace-constituent tolerant species of filamentous algae". According to a USGS report (1992), "water quality problems on Short Creek, a small intermittent stream, are caused by a combination of mine-water seepage, seepage from a 40-acre phospo-gypsum pile, and runoff from an abandoned lead and zinc smelter". According to Industrial Economics, Inc (2009), found that "Short Creek's sediments are also contaminated with frequent exceedances of the TEC, PEC and OMOE-Severe, particularly (but not only) by zinc". Also, Dames & Moore (1995) determined that "Short Creek macroinvertebrates exhibited the lowest species richness of all streams investigated. Dissimilarity between macroinvertebrate communities upstream and downstream of the Joplin Designated Area (DA) on Short Creek indicates that industrial and mining activities may have altered the structure and function of these communities".

The Missouri Department of Natural Resources (MDNR) has indicated that planned remediation of the 40-acre PCS Phosphate phosphor-gypsum pile will likely cause increase flow in Short Creek and the transportation of sediments downstream into Kansas near the EaglePicher smelter.

For these reasons, it is suggested that efforts to remove all contaminated sediment below the high-water mark of Short Creek would be counterproductive since erosion would be enhanced by removal of established vegetation and alteration of existing flow regimes and the presence of upstream sources of contaminants. Further contributions of contaminants from the upland areas of the Trust property will be greatly reduced by the removal and covering of impacted soils, including the mercury settling ponds. The conclusion reached from this evidence is that removal of the sediment from Short Creek, as planned under Alternative 2, will not significantly improve stream habitats due to other inherent sources of contamination in the drainage basin and thus not create a positive long-term overall effect.

(4) Reduction of Toxicity, Mobility, or Volume through Treatment: Alternative 2 may increase the risk of mobility of residual contaminated sediments by changing existing flow regimes in Short Creek and exacerbate erosion. Neither alternative reduces the volume of contamination through treatment.

(5) Short-Term Effectiveness: Both Alternatives 2 and 3 will take three to six months to complete and involve the movement of large amounts of contaminated soil and waste. However, site workers and nearby residents would experience negligible exposure to site contaminants during construction through the use of dust suppression techniques such as roadway watering and enclosed equipment cabs. Revegetation under either Alternative 2 or 3 is expected to take approximately 3 years to fully develop and flourish. Intermediate plant growth and use of other erosion control techniques will minimize soil erosion in the

interim under typical precipitation and stream flow events. Alternative 1 could be completed in a matter of months if implemented with minimal disturbance to the Site.

(6) Implementability: There are no implementability issues associated with Alternative 1. Alternative 2 presents implementability issues associated with flash-flooding events during construction and long-term erosion and sediment transport issues after construction. Implementability is increased with Alternative 3 since limited spot-removal of mercury contaminated sediment is proposed to be performed within the high-water mark of Short Creek, other than the removal of limited "hot-spots" identified on the north side of Short Creek.

(7) Cost: There are no cost issues associated with Alternative 1. Alternatives 3 is estimated to cost $220,000 less than Alternative 2 due to decreased material removal and restoration. Both Alternative 2 and 3 appear to be within the funding limitations of the Trust.

(8) State Acceptance: State acceptance will be sought based on KDHE review and comment on this Evaluation of Cleanup Alternatives Report.

(9) Community Acceptance: Community acceptance will be sought through the mandatory public review and comment process.

10.0 IDENTIFICATION OF RECOMMENDED CONCEPTUAL REMEDIAL ALTERNATIVE

Alternative 1 is not recommended since it is not fully protective of human health or the environment. Alternative 2 is not recommended due to the possible deleterious effects of removing sediment from Short Creek and exacerbation of erosion and migration of remaining sediments after project completion. As indicated both up-gradient and down-gradient segments of Short Creek are also contaminated by lead, arsenic, cadmium and zinc as a result of historical mining operations in the area. In addition, existing upstream sources (PCS Phosphate Facility) of contamination will continue to cause migration of contaminants into Short Creek near the site. Alternative 3 is recommended as the preferred remedial alternative for the Site. Alternative 3 incorporates excavation, consolidation and capping of contaminated soil and waste in a cell located on the western part of the AOC. The cap will consist of an engineered designed cover to prevent further human and environmental exposure to the contamination and limit the migration of contamination through the consolidation cell. EUCs will be placed on the consolidation cell to prevent future development and other activity on the consolidation cell. A limited spot-removal (Geomorphic sediment removal) of mercury contaminated sediment will reduce the volume of mercury related contamination in Short Creek. Localized geomorphic sediment removal will minimize negative physical impacts (erosion, bank instability, etc.) to Short Creek. Alternative 3 meets the RAOs defined for the Site.

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