SIXTH FIVE-YEAR REVIEW REPORT FOR

CHEROKEE COUNTY SUPERFUND SITE

CHEROKEE COUNTY, KANSAS

Prepared by

U.S. Environmental Protection Agency
Region 7
Lenexa, Kansas

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LIST OF ABBREVIATIONS & ACRONYMS

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
EUC	Environmental Use Control
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
IEUBK	Integrated Exposure Uptake Biokinetic Model
IGWUA	Intensive Groundwater Use Area
KDHE	Kansas Department of Health and Environment
MCL	Maximum Contaminant Level
NPL	National Priorities List
O&M	Operation and Maintenance
ORD	Office of Research and Development
OU	Operable Unit
ppm	parts per million
PRG	preliminary remediation goal
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objectives
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
TBC	To be considereds
TEC	Threshold Effects Concentration
TI	Technical Impracticability
TSMD	Tri-State Mining District
UU/UE	Unlimited use and unrestricted exposure

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy to determine whether the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 121, consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. § 300.430(f)(4)(ii)), and considering EPA policy.

This is the sixth FYR for the Cherokee County Superfund site (Site). The triggering action for this statutory review is the completion date of the previous FYR on September 15, 2015. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of nine OUs, six of which will be addressed in this FYR. The status of these OUs is summarized in the table below:

Table 1: Status of OUs

Operable Unit	Status
01 – Galena Alternate Water Supply	Complete
02 – Spring River Basin	Remedial Investigation
03 – Baxter Springs	Under Construction
04 – Treece	Under Construction
05 – Galena Groundwater/Surface Water	Operation and Maintenance
06 – Badger, Lawton, Waco, and Crestline	Under Construction
07 – Galena Residential Soils	Operation and Maintenance
08 – Railroads	Remedial Design
09 – Tar Creek Watershed	Remedial Investigation

This FYR evaluates the remedies implemented at OU1, OU3, OU4, OU5, OU6, and OU7. The remaining OUs not addressed in this FYR are OU2, OU8, and OU9. The OU1 remedy is complete. It included the development of a water purveyance system, which is operated and maintained by a rural water district (RWD) under the Kansas requirements and acceptable operations for public water systems.[1] The OU8 remedy is in the Remedial Design status and the selected remedy has not yet been implemented. OU2 and OU9 are under Remedial Investigation and neither OU has a Record of Decision (ROD).

The Cherokee County Superfund Site FYR was led by Eduardo A. Ortiz of the EPA, a Remedial Project Manager for the Site. Participants included Elizabeth Hagenmaier, EPA Remedial Project Manager; Todd Campbell, EPA On-Scene Coordinator; Griffith Hoffman, EPA Superfund intern; Jane Kloeckner,

[1] KDHE, Kansas Administrative Regulations, 28-15-18, et. seq.

EPA Attorney; Danny Lyskowski, EPA Attorney; Elizabeth Kramer, EPA Community Involvement Coordinator; Venessa Madden, EPA Ecological Risk Assessor; Todd Phillips, EPA Human Health Risk Assessor; and Jesse Kidwell, EPA Hydrogeologist. Austin Clapp, Kansas Department of Health and Environment (KDHE) Unit Chief, and Chris Hase, KDHE Project Manager, assisted in the review as the representatives of the support agency.

The review began on 6/24/2019.

Site Background

The Site represents the Kansas portion of the Tri-State Mining District (TSMD). The TSMD encompasses approximately 2,500 square miles in Oklahoma, Kansas, and Missouri, and was formerly one of the richest lead and zinc ore-producing deposits in the world. The Kansas portion of the TSMD lies within the extreme southeast corner of the state. The Site is 115 square miles in size. The Site is divided into seven subsites that are grouped and divided into nine operable units.

Lead and zinc mining was conducted at the Site for over 100 years from the middle 1800s to 1970, and the primary contaminants of concern (COCs) are lead, zinc, and cadmium. The TSMD is characterized by a variety of mine waste features that include the following: large piles of sand- and gravel-sized mill tailings locally known as chat; piles of overburden bedrock materials locally known as bullrock; tailings impoundments and ponds that contain accumulations of silt- and clay-sized flotation tailings; open and collapsed mine shafts, sometimes filled with water; and subsidence features. The primary sources of contamination at the Site are the residual metal sulfides in the abandoned mine workings, chat piles, and tailing impoundments, in addition to historic impacts from smelting operations. Upon exposure to the atmosphere, metal sulfides can become oxidized and mobilize as dissolved compounds which increase the acidity of surface water and groundwater. The resulting metal-laden acidic water, referred to as acid mine drainage, can further leach metals from bedrock, contaminate groundwater, and fill mine shafts and subsidence features. The acid mine drainage can also surface through springs and combine with metal-laden surface water runoff to ultimately contaminate rivers, creeks, and lakes. The shallow aquifer is impacted by heavy metals as a result of past mining practices.

The mine waste areas contain sparse to no vegetation. Local stream systems also contain mining wastes and mining-impacted sediments and surface water. The Site is underlain by two aquifers separated by a confining unit. The shallow aquifer is comprised of Mississippian limestones which also host the lead-zinc deposits that were mined at the subsites. Water quality in the shallow aquifer is generally poor, with some water samples exceeding Maximum Contaminant Levels (MCLs) for arsenic, cadmium, lead, mercury, and nickel.

Residential areas are adjacent to mine waste accumulations in some areas or have suffered historic impacts as a result of smelting. Lead and zinc are found in mining wastes and soils at maximum concentrations of several thousand parts per million (ppm), while cadmium is typically found at levels less than 500 ppm.

The Site was listed on the National Priorities List (NPL) in September 1983. Site-wide, over thirteen million cubic yards of mining wastes have been remediated on over 2,800 acres; over 800 residential yards have been remediated; and over 500 homes have been supplied with a clean, permanent source of drinking water. An EPA field office has been established near the Site to better oversee the many engineering designs, site characterizations, and remedial actions (RAs) that are underway in addition to monitoring, and operation and maintenance (O&M) activities for the many completed remedies.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Cherokee County		
EPA ID: KSD980741862		
Region: 7	**State:** KS	**City/County:** Cherokee County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA		
Author name (Federal or State Project Manager): Elizabeth Hagenmaier		
Author affiliation: U.S. EPA Region 7		
Review period: 6/24/2019 - 8/6/2020		
Date of site inspection: 3/10/2020 – 3/11/2020		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/15/2015		
Due date *(five years after triggering action date)*: 9/15/2020		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The COCs for soil, groundwater, surface water, and sediments are lead, cadmium, and zinc.

The Site is a concern because of the mining and milling wastes remaining on the surface throughout the county. These wastes constitute a significant source of heavy-metals contamination, with the potential for exposure to people and environmental receptors, which have resulted in the contamination of surface soil, sediments, surface water and groundwater in the shallow aquifer.

Human Health Exposure

In 1989, the Agency for Toxic Substances and Disease Registry (ATSDR) completed a Preliminary Health Assessment for the Galena subsite. The study indicated that "lead and cadmium in surface soil, surface water, and groundwater, are found at levels that are of public health concern." Children were identified as the main sensitive subpopulation of concern because of their potential exposure to

contaminated soil and surface water. ATSDR concluded that the Site was a public health concern because of the risk to human health caused by the probable human exposure to hazardous substances at concentrations that may result in adverse health effects.

The OU5 1989 ROD for the Galena subsite concluded that exposure to the metals found in the private wells may cause harm to human health.

For OU3 and OU4, a baseline human health risk assessment was conducted by a group of potentially responsible parties (PRPs) in 1991 under an Administrative Order of Consent (AOC). Potential health effects from exposure to lead were evaluated using the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model. The results predicted by the IEUBK model indicate that the concentrations of lead currently present in soils at these subsites present an unacceptable risk to the children living in residences located on or near mine wastes. The concentration of lead in residential soils is the main concern for the uptake of lead and projected elevated blood lead levels under both current and future residential land use scenarios.

Like the conclusions for OU3 and OU4, the human health risk assessments completed for all OUs addressed in this FYR concluded that, in general, lead is the primary human health risk at the Site. In addition, these assessments concluded that cadmium has the potential to create an unacceptable risk resulting from the ingestion of vegetables or groundwater. Vegetables have been demonstrated to readily uptake cadmium and thus pose a potential health threat.

Ecological Exposure

For OU5, the 1989 ROD concluded that both the acute and chronic exposure levels for aquatic life for cadmium and zinc are exceeded in Short Creek and its tributaries. The chronic exposure level for lead is also exceeded in Short Creek. The Spring River is impacted by mining activities in both Missouri and Kansas. Within the Galena subsite, both Short Creek and Shoal Creek discharge into the Spring River. The chronic exposure level for aquatic life for zinc is exceeded in the Spring River within the Galena subsite.

For OU3 and OU4, an Ecological Risk Assessment (ERA) was conducted which indicated that there was a significant and unacceptable risk to both aquatic and terrestrial organisms present at these subsites. Per request, ecological preliminary remediation goals (PRGs) for cadmium, lead, and zinc in soil and sediment for the Site were developed in 2006 by an EPA Ecological Risk Assessor.

For the OU6 subsites, ecological risks constitute the primary site risks and are present due to elevated levels of heavy metals in mining wastes, soils, sediments, groundwater, and surface water within the subsites. Ecological receptors are exposed to heavy metals primarily by ingestion of impacted mine wastes, soils, surface water, vegetation, and prey as well as inhalation of toxic dusts. Zinc, lead, and cadmium are the major COCs for ecological receptors and also represent the principal threats.

Response Actions

Several RODs have been issued and many cleanups have been completed or are currently underway. Several enforcement instruments with responsible parties have also been completed, and responsible parties have funded and conducted many cleanups at the Site, in addition to cleanup actions funded and implemented by the EPA and KDHE. Bankruptcy settlements have also yielded monies for site use in

addition to American Recovery and Reinvestment Act funding. A summary of enforcement instruments is found in Appendix C. Table 2 includes all action and/or cleanup levels associated with each OU.

Table 2: All Action And/Or Cleanup Levels Associated with Each OU

OU	OU1			OU3/4									OU4		
Media	Groundwater			Soil/Mine Waste (biota risks)			Soil/Mine Waste (human health risks)			Surface Water			Intermittent Stream Sediments		
	COC	Cleanup Level	Units	COC	Cleanup Level	Units	COC	Cleanup Level (Action Level)	Units	COC	Cleanup Level	Units	COC	Cleanup Level	Units
	Cadmium	10	µg/L	Cadmium	10	ppm	Cadmium	25 (75)	ppm	Cadmium	WER[EXP[(0.7852*(LN(hardness)))-2.715]]	Water Effects Ratio	Cadmium	17	ppm
	Lead	50	µg/L	Zinc	1076	ppm	Lead	500 (800)	ppm	Zinc	WER[EXP[(0.8473*(LN(hardness)))+0.884]]	(WER) of 1.0 and	Zinc	2949	ppm
	Selenium	10	µg/L	Lead	400	ppm				Lead	WER[EXP[(1.273*(LN(hardness)))-4.705]]	hardness is in mg/L	Lead	219	ppm
	Zinc	5000	µg/L												
Source	OU1 ROD			OU3/4 ROD Amendment			OU3/4 ROD; EPA remediated yards that met the action levels to the cleanup level or until a one-foot depth			OU3/4 ROD Amendment; Kansas Aquatic Chronic Life Criteria, hardness dependent, incorporated into the Tar Creek TMDL (https://www.kdheks.gov/tmdl/ne/TarCreek_Metals.pdf)			OU3/4 ROD Amendment no. 2		

OU	OU5											
Media	Soil/Mine Waste			Groundwater				Surface Water				
	COC	Cleanup Level	Units	COC	Cleanup Level	Units	Source	COC	Cleanup Level	Units	Source	
	Cadmium	25	ppm	Arsenic	50	µg/L	1, 3	Arsenic	190	µg/L	1, 2	
	Zinc	10000	ppm	Barium	1000	µg/L	1, 3	Cadmium	0.66	µg/L	2	
	Lead	1000	ppm	Cadmium	5	µg/L	3	Chromium	11	µg/L	1, 2	
				Chromium	50	µg/L	1, 3	Copper	6.5	µg/L	2	
				Copper	1000	µg/L	1, 3	Iron	1000	µg/L	1, 2	
				Iron	300	µg/L	2, 3	Lead	1.3	µg/L	2	
				Lead	50	µg/L	1, 3	Mercury	0.012	µg/L	1, 2, 3	
				Manganese	50	µg/L	2, 3	Nickel	88	µg/L	2	
				Mercury	2	µg/L	1, 3	Selenium	5	µg/L	3	
				Nickel	1000	µg/L	3	Silver	0.12	µg/L	1, 2	
				Selenium	10	µg/L	1	Zinc	59	µg/L	2	
				Silver	50	µg/L	1, 3					
				Zinc	5000	µg/L	1, 3					
Source	OU5 ROD			OU5 ROD; Table 8 of the OU5 ROD includes assumptions. For the purposes of this FYR, the lowest applicable level was included. 1. Primary MCL 2. Secondary MCL 3. Kansas Action Level				OU5 ROD; Table 8 of the OU5 ROD includes assumptions. For the purposes of this FYR, the lowest applicable level was included. 1. Federal Aquatic Life 2. Kansas Chronic Aquatic Life 3. Alternative Kansas Notification/Action Levels (Chronic) to aquifers that surface through springs or seeps *Hardness dependent; see Table 8 in OU5 ROD for assumptions				

OU	OU6														
Media	Soil/Mine Waste (biota risks)			Soil/Mine Waste (human health risks)			Groundwater			Surface Water			Sediment		
	COC	Cleanup Level	Units	COC	Cleanup Level (Action Level)	Units	COC	Cleanup Level	Units	COC	Cleanup Level	Units	COC	Cleanup Level	Units
	Cadmium	10	ppm	Cadmium	25 (75)	ppm	Cadmium	5	µg/L	Cadmium	(= EXP (0.7409*[hardness]-4.719)		Cadmium	0.99	ppm
	Zinc	1076	ppm	Lead	500 (800)	ppm	Lead	15	µg/L	Zinc	(= EXP (0.7409*[hardness]-4.719)	Hardness is in mg/L	Zinc	121	ppm
	Lead	400	ppm				Zinc	5000	µg/L	Lead	(= EXP (0.7409*[hardness]-4.719)		Lead	35.8	ppm
Source	OU6 ROD			OU6 ROD; EPA remediated yards that met the action levels to the cleanup level or until a one-foot depth			OU6 ROD			OU6 ROD; Kansas Aquatic Chronic Life Criteria, hardness dependent, incorporated into the Spring River TMDL. (https://www.kdheks.gov/tmdl/download/spring_metals.pdf)			OU6 ROD; MacDonald (2000) TEC or Background Sediment Criteria		

OU	OU7		
Media	Residential Soil		
	COC	Cleanup Level (Action Level)	Units
	Cadmium	25 (75)	ppm
	Lead	500 (800)	ppm
Source	OU7 ROD; EPA remediated yards that met the action levels to the cleanup level or until a one-foot depth		

LEGEND:

MCL – Maximum Contaminant Level
ppm – parts per million
µg/L – micrograms per liter

OU1 - Galena Alternate Water Supply

OU1 is part of the Galena subsite. A remedial investigation (RI) addressing the alternate water supply was completed in 1987. The RI concluded that a number of private wells were contaminated with metals that exceed the primary and secondary MCLs established by the Safe Drinking Water Act. Due to the concern for the health of persons drinking this contaminated water, the EPA conducted a removal action and installed water treatment units on these wells with permission of the property owners. The EPA signed the alternative water supply ROD in December 1987 and issued an Explanation of Significant Differences (ESD) in July 1989. The following Remedial Action Objectives (RAOs), referred to as remediation goals in the 1987 ROD, and remedy components were selected in the ROD:

RAOs of the remedy selected:

- Provide suitable drinking water to the population within the subsite.
- Protect the deep aquifer from contamination that could occur as a direct or indirect result of implementing an alternative water supply.

Remedy Components:

- Collection of water from the Roubidoux aquifer through existing wells owned by the city of Galena, and distribution of that water through a pipeline network to the houses, businesses, and farm within the subsite but outside of the Galena municipal water system.
- Rehabilitate the city of Galena's existing wells number one and two to provide additional capacity for the expanded system.
- If rehabilitation is not an option, a new well will need to be drilled.

The 1989 ESD modified the selected remedy requiring the expansion of the existing municipal water system, which included the installation of a new well to meet the increased water demands; and a distribution system, a new RWD, to service the residents within the area between Galena and the Spring River, including the Lowell area.

OU3 - Baxter Springs subsite and OU4 - Treece subsite

The EPA, through its enforcement authorities, negotiated an AOC with certain PRPs to conduct the RI and feasibility study (FS) for both the Baxter Springs and Treece subsites, OU3 and OU4. The RI and FS were completed in 1993. The EPA signed a ROD for OU3/OU4 in 1997. The remedy was amended in 2006 and 2016 with ROD Amendments. An ESD in 2010 to the Tar Creek Superfund site included the residential buyout of the city of Treece in the Treece subsite. An Action Memorandum for an emergency removal action was signed in 2018 to provide alternate water to a residential property in OU3.

1997 ROD

The EPA published its selected remedy for the Baxter Springs and Treece subsites in the August 1997 ROD. The ROD includes remedial actions for the source materials at the Baxter Springs subsite (mining/milling wastes) and addresses groundwater, surface water, soils, and residential yard cleanups for both the Baxter Springs and Treece subsites. The EPA incorporated the same residential cleanup decision from the Galena subsite, OU7, to the extent the investigation of residential yards showed contamination at levels of concern.

RAOs of the remedy selected:

Surficial Material

- Prevent direct contact with, ingestion of, and/or inhalation of metal COCs from on-site surficial materials that would potentially result in an excess cancer risk greater than 10^{-4}, a non-carcinogenic hazard index of greater than 1, or blood lead levels causing excessive health risks.
- Prevent the exposure of terrestrial biota to metal contaminants in surficial materials that would potentially result in excessive ecological risks associated with bioconcentration of site COCs.

Groundwater

- Prevent the release to surface water of groundwater containing metal COCs that would result in exceedances of surface-water applicable or relevant and appropriate requirements (ARARs) and excessive ecological risks in the Baxter Springs/Treece subsites.
- Prevent potential degradation of conditions in the Tar Creek Superfund site in Oklahoma resulting from implementation of remedial actions within the Baxter Springs or Treece subsites, and formulate remedial alternatives for the Baxter Springs and Treece subsites that would be consistent with and/or supplemental to actions taken for the Tar Creek site.
- Prevent risks associated with domestic usage of groundwater supplies containing concentrations of metals exceeding appropriate ARARs for the Boone aquifer.
- Prevent exceedances of appropriate ARARs resulting from the downward migration of metal COCs in shallow (Boone) groundwater and/or mine water from on-site mining related sources to the deep (Roubidoux) aquifer.

Surface Water

- Prevent the transport of metal contaminants and sediments containing metal contaminants from on-site sources that would result in exceedances of surface water ARARs and/or excessive ecological risks in the subsite streams and the Spring and Neosho Rivers.
- Prevent exposure of aquatic biota to metal contaminants in surface waters that would result in excessive ecological risks.

Remedy Components:

The major components of the selected remedy, which are specific to only the Baxter Springs subsite, included the following:

- excavation, relocation, regrading, capping, and revegetation of mine/mill waste piles, tailings impoundments, and tailings outwash deposits;
- stream re-channelization and construction of stream diversion/control structures; and
- prevention of mine water discharges.

The major remedy components for both the Baxter Springs and Treece subsites include the following:

- investigation and potential remediation of residential yards impacted by mining/milling wastes;
- closure/abandonment of poorly constructed existing deep water wells and borings to protect the deep aquifer;
- institutional controls (ICs) for future development; and
- O&M of all remedy aspects which include, but are not limited to, the following: capped areas; stream diversion/control structures; ICs; and long-term monitoring.

The 1997 ROD also included a Technical Impracticability (TI) waiver for all surface water and shallow groundwater at the subsites. Groundwater RAO No. 3, preventing human health risks due to domestic

consumption of shallow groundwater, will be addressed through implementation of institutional water management strategies at both subsites. These restrictions can be implemented by requiring the Division of Water Resources to form an Intensive Groundwater Use Area (IGWUA) which will prohibit the future drilling of shallow water wells for domestic use within both subsites through legal and/or administrative restrictions on the installation of new domestic shallow wells. The local municipal and county governments will be encouraged to use the IGWUA to place restrictions on shallow groundwater usage. These restrictions will have the effect of requiring future residents to connect to existing Rural Water District supplies, thereby preventing human consumption of shallow aquifer and/or impacted mine water. The effectiveness of ICs is dependent upon the actions of local officials and citizens as well as support by KDHE.

The 1997 ROD for OU3/OU4 concludes that remediation of future residential development sites shall be the responsibility of the property owner or the responsible party. The county will be encouraged to provide oversight and enforcement of these restrictions on future development through implementation of an Environmental Health Program. The goal is to enact and enforce ICs that are applicable for the entire county and thus include all response actions performed at various operable units or sub-areas of the county-wide site. In addition, all areas subject to the Environmental Health Program will be identified on a map which will be available, filed, and recorded at the Cherokee County Recorder of Deeds Office at the county seat in Columbus, Kansas. This map will be recorded as soon as possible after implementation of the program. All mine waste areas located in the Cherokee County Superfund site will be affected by these ICs. A monitoring program will be established to assess new construction of residences in these subsites, enforcement of the ICs, and the distributions from the financial lead.

2006 ROD Amendment

The OU3/OU4 remedy was modified in September 2006 and included the following RAOs and remedy components:

RAOs of the remedy selected:

Source Materials and Soil

- Prevent human ingestion of COCs (cadmium, lead and zinc) from source materials that would potentially result in cancer risks greater than 10^{-6}, noncarcinogenic hazard indexes greater than 1, or blood lead levels causing unacceptable human health risks (10 micrograms per deciliter [µg/dl] for children).
- Prevent the ingestion exposure of biota to COCs (cadmium, lead and zinc) in source materials that would potentially result in excessive ecological risks.

Surface Water

- Prevent ingestion and dermal exposure of biota to surface waters exceeding Kansas Aquatic Chronic Life Criteria, resulting from the release and transport of COCs (cadmium, lead, and zinc) from source materials (mine wastes) and non-residential soils within the subsites.
- Prevent ingestion and dermal exposure to aquatic biota of COCs (cadmium, lead and zinc) by controlling the erosion and transport of mine wastes to surface water.

Remedy Components:

- excavate, consolidate, and/or cap all surficial mine waste followed by disposal and capping;
- utilize subaqueous mine waste disposal to the maximum extent practicable;
- encourage source reduction via responsible chat sales before and during remedy implementation;

- conduct O&M after the source reduction activities, which will include at least inspections of the soil/clay caps; select surface water monitoring in and downstream of the sedimentation basins; and, if deemed applicable, groundwater monitoring in areas of subaqueous disposal; and
- adopt ICs for future development specified in an earlier ROD.

In addition to the amended remedy, the 2006 ROD Amendment retracted the TI waiver for surface water. The goal of the remedy is now to meet chemical-specific ARARs for surface water throughout OU3/OU4.

2010 ESD to Tar Creek Superfund site ROD

In 2010, EPA Region 6 revised their ROD for OU4 – Chat Piles, other Mine and Mill Waste, and Smelter Waste to address the residential buyout of the city of Treece in Kansas. Their ROD was originally signed in 2008. The ROD included a residential buyout that was managed by The Lead Impacted Communities Relocation Assistance Trust. The buyout was initiated in 2009 and included residents of Picher and Cardin, Oklahoma, and Treece, Kansas. The decision to relocate the residents of Treece, Kansas, was documented in an ESD to the OU4 ROD issued in April 2010.

2016 Amendment No. 2 to the 1997 ROD
The OU4 remedy was modified in September 2016 and included the following RAOs and remedy components:

RAOs of the remedy selected:
- Prevent exposure to impacted source materials, soils, surface water, and sediment.
- Control the erosion and transport of mine wastes to surface water, and the transport of mine waste from contaminated sediments in the intermittent tributary of Tar Creek.

Remedy Components:
- Excavate, consolidate, and/or cap all surficial mine waste followed by disposal and capping;
- Excavate, consolidate, and/or cap all contaminated intermittent stream sediments followed by disposal and capping;
- Utilize subaqueous mine waste disposal to the maximum extent practicable;
- Encourage source reduction via responsible chat sales before and during remedy implementation;
- Conduct O&M after the source reduction activities which will include at least inspections of the soil/clay caps, and select surface water monitoring in and downstream of the sedimentation basins; and
- Adopt ICs for future development specified in an earlier ROD.

The major change in OU 04 added by Amendment No.2 is to address the sediments in the intermittent stream, Tar Creek in Kansas, known as the North West Tributary.

Action Memorandum for Emergency Removal Action at OU3 (2018)

The selected option for this action at property 595 Ballard Road in Baxter Springs is to contract with the local Rural Water District to provide a tap, a meter, and a location with an appropriate utility easement to hook up the existing water supply line to the rural water system so the residents will be able to use rural water as a potable water source rather than the contaminated groundwater. The EPA will then plug

the shallow water well so that current or future residents will not be exposed to the contaminated well water or have it readily accessible for future use.

OU5 - Galena Groundwater/Surface Water

An RI addressing the Galena groundwater/surface water was initiated in 1988. The EPA signed the OU5 ROD in September 1989. The following RAOs, referred to as remediation goals in the 1989 ROD, and remedy components were selected in the ROD:

RAOs of the remedy selected:

Long-term Remediation Goals

- Protect the Roubidoux Aquifer from contaminant inflows within the bounds of the subsite.
- Protect human health of the population within the subsite from mining-related contaminants in the groundwater and surface water systems and in the surface mine wastes and soils.
- Meet Kansas Ground Water Contaminant Cleanup Target Concentrations in groundwater within the subsite.
- Meet both federal and state Ambient Water Quality Criteria (AWQC) in surface streams within the subsite.

Short-term Remediation Goals

- Protect the Roubidoux Aquifer from deep well contaminant inflows within the subsite.
- Protect human health of the population within the subsite from mining-related contaminants in the groundwater and surface water systems and in the surface mine wastes and soils.
- Provide suitable drinking water (meeting primary MCLs at existing taps) for the population within the subsite.
- Reduce metals loading in Short Creek, Shoal Creek and Spring River to support sitewide goals.
- Improve water quality of the shallow aquifer within the Galena subsite.

In the development and detailed evaluation of the selected remedy, the description includes the following goals that would be achieved with the actions in the selected remedy:

- Eliminate human exposure via ingestion to contaminated mine wastes and reduce long-term shallow groundwater and surface water metals loading.
- Minimize recharge to the shallow groundwater system.
- Reduce infiltration through the cover material, promote proper surface drainage, and control erosion.

Remedy Components:

- Mine, characterize and selectively place surface-deposited mine wastes (waste rock and chat) in open subsidences, pits and shafts.
- Divert and rechannel certain surface drainages, and recontour and vegetate the ground surface to the extent possible.
- Investigate and remediate wells penetrating the deep aquifer to protect against contamination from the shallow aquifer and mining-related activities.
- Monitor surface water quality in Short Creek to determine the effectiveness of the remedial action.
- Utilize land use restrictions as ICs to prevent damage to restructured channels and recontoured and vegetated surfaces.

- Utilize deed restrictions as ICs, which may include restrictions on future mining activities, water well construction, excavation of backfilled shafts and subsidences, and other construction in the areas affected by this remedial action.
- The state of Kansas may consider establishing a Ground Water Management District program for the subsite to limit the use of shallow groundwater for drinking water, pursuant to Kansas Administrative Regulations 28-30 and K.S.A. 82a-1036.

The 1989 ROD also indicated that the selected alternative did not meet chemical-specific ARARs for groundwater and surface water but will reduce mass metals loading. These ARARs include attaining the MCLs in the groundwater and the AWQC in the surface water and the equivalent state standards. This TI waiver for chemical-specific ARARs applies to the shallow groundwater and surface water in Short Creek in the Galena subsite. The 1989 ROD summarized that the public health risks from ingestion of contaminated shallow groundwater may not be significantly reduced under this remedy; however, the alternative water supply, as described in the OU1 ROD of December 1987 for the Galena subsite, provides a remedy for this public health concern. Pursuant to the 1993 EPA TI Guidance, the EPA selected an alternative remedial strategy that included source control and exposure control. To meet the need for source control, there are remediation goals and remedy components for addressing the mine waste, surface drainages, and well plugging. For exposure control, the remedy included ICs such as deed restrictions and establishing a Ground Water District program through the state of Kansas. The 1989 ROD concluded that there may be continued health risks associated with ingestion of the shallow groundwater in the subsite.

OU6 - Badger, Lawton, Waco, and Crestline Subsites

This OU consists of four distinct geographic subsites with PRP involvement at the Waco and Crestline subsites, exclusive EPA fund-lead activities at the Badger and Lawton subsites, and joint EPA/PRP work at the Waco subsite. The RI/FS was conducted by the PRPs under an AOC issued in 1998. The RI/FS was completed in 2004 and a ROD was issued in 2004.

RAOs of the remedy selected:

Soils and Source Materials

- Prevent human ingestion of COCs from on-site soils or source materials that would potentially result in cancer risks greater than 10^{-6}, non-carcinogenic hazard indexes greater than 1, or blood lead levels causing unacceptable human health risks. Soils or source materials containing less than 800 parts per million lead and less than 75 ppm cadmium are deemed acceptable for preventing these potential human health risks.
- Prevent the exposure of biota to COCs in materials that would potentially result in excessive ecological risks.

Surface Water and Sediment

- Prevent exposure of biota to surface waters exceeding Kansas Aquatic Life Criteria and sediments exceeding MacDonald Threshold Effects Concentration (TEC) values, or background sediment values, resulting from the release and transport of COCs from mine wastes within the subsites.
- Prevent risks to biota by controlling the erosion and transport of mine wastes and impacted sediments.

Groundwater

- Prevent human ingestion of COCs in subsite groundwater at concentrations exceeding the National Primary and Secondary Drinking Water Standards.
- Prevent exceedances of drinking water standards caused by the downward migration of site-related groundwater from the shallow Boone aquifer to the deep Roubidoux Aquifer.
- Prevent the discharge of groundwater containing site-related COCs that would result in exceedances of surface water and sediment criteria or cause excessive ecological risks.

Remedy Components:

- Excavate, consolidate, and/or cap all surficial mining wastes and excavate metals-impacted sediments from all ephemeral streams. Mining wastes in heavily forested, thickly vegetated areas will not be subject to excavating, consolidating, or capping.
- Utilize subaqueous mine waste disposal to the maximum extent practicable, with the exception of remedial actions at the Badger subsite. For the Badger subsite, excavate mill wastes and dispose of materials in repositories located outside the limits of the 100-year floodplain of the Spring River.
- Cap subsidence pits, consolidation areas, tailings impoundments, and in-place chat/tailings areas utilizing topsoil and compacted clay caps with a minimum total thickness of 1.5 feet. The use of other materials in conjunction with soil, such as fly ash, is acceptable pending a successful assessment of viability.
- Re-contour and re-vegetate all disturbed areas and facilitate drainage and erosion controls. Construct sedimentation basins, detention ponds, dikes, berms, and swales to the extent necessary to control run-on and run-off.
- Abandon deep wells to prevent cross-contamination between the shallow and deep aquifers.
- Perform a design investigation to characterize the groundwater flow system to monitor the subaqueous mine waste disposal component of the remedy and to determine the need for groundwater ICs.
- Assess the sediments of any water-filled shafts, pits, ponds, or collapse features not filled during the remedial action. Provide suitable cover, such as soil or rip rap, on near shore sediments that exceed numeric or site-specific criteria.
- Conduct O&M with requirements of maintaining the integrity of the capped areas, and monitoring and assessment during the FYR process in addition to the ICs.
- Adopt the county-wide ICs from the Baxter Springs and Treece ROD, specifically, restrictions on new residential development in mine waste areas, controls on the drilling and design of new domestic water supply wells, and encouragement of local citizens to utilize existing RWDs for domestic needs.

OU7 - Galena Residential Soils

The OU7 RI/FS was initiated in 1984 and completed in May 1996. Before the ROD was completed at OU7, removal actions were completed that involved the remediation of residential yards that were significantly impacted by elevated levels of lead. The EPA signed the OU7 ROD in July 1996. The following RAOs and remedy components were selected in the ROD:

RAOs of the remedy selected:

- Reduce public exposure, and particularly children's exposure, to residential soils with elevated lead and cadmium resulting from past mining, milling, and smelting activities.

Remedy Components:

- Excavation and disposal of residential soils impacted by mining wastes;
- Health education for the general community and medical professionals;
- ICs to guide future development in residential areas impacted by mining wastes;
- Treatability studies to evaluate the effectiveness of phosphate stabilization as a future alternative; and
- O&M of all remedy aspects including, but not limited to, health education, ICs, and long-term monitoring.

The O&M program will ensure the implementation of ICs and assess effectiveness. ICs will be implemented at the local level and include such items as deed restrictions, special building codes, ordinances, and zoning restrictions designed to prevent future exposure to, and disturbance of, mining wastes and preserve the integrity of the remedy. The continuation of the health education program is a component of O&M and includes such actions as providing educational materials, seminars, and other such activities. The education program will continue to reduce residual risks by the provision of educational materials. The current program may be modified as necessary during and after implementation of the remedy.

Status of Implementation

Contaminated media at the Site includes mine waste (source material), soils, groundwater, sediments, and surface water. The COCs are zinc, lead, and cadmium. The status of the implementation of remedies for each OU is described below.

OU1 – Galena Alternate Water Supply

The remedy for OU1, as amended, has been completed. The remedial action included establishing a RWD and installing the associated water supply wells, city of Galena interconnections, and 57 miles of pipeline to provide nearly 500 residences and 1,500 people with a permanent source of clean drinking water. The ESD, finalized in July 1989, added the area north of Galena to the Galena subsite and modified the remedy. Two water wells were determined to be constructed and maintained independent from the city of Galena. As an exception, the city of Galena would provide water to residences on the southeastern edge of the city. Construction activities began on December 1989 with the installation of two water storage tanks and the drilling of two water supply wells. On January 4, 1994, a final inspection for the Alternate Water Supply was conducted with all major deficiencies corrected, which did not affect the operation of the water systems. The public water supply systems are operated and maintained by a RWD and the city of Galena under the Kansas requirements and acceptable operations for public water supply systems (see KDHE, Kansas Administrative Regulations, 28-15-18, et. seq). No further response actions have been conducted and this OU is considered complete. Therefore, except for the O&M discussion below, this OU will not be discussed further in this FYR.

OU3 – Baxter Springs subsite

Many phases of work have been completed, are underway, and have been or are being conducted by PRPs and the EPA at this subsite. Response actions at this OU were conducted by PRPs under a Consent Decree (CD) signed in 1999, and include residential and surficial mine waste components that were completed and are now in O&M. EPA response actions have been for mine waste with at least one residential yard response since the completion of the PRP response.

The residential aspect of the PRP response action included sampling and remediation as necessary of residential soils from properties impacted by mining activities. Properties with lead values exceeding the action levels of 800 ppm lead or 75 ppm cadmium were excavated until cleanup levels for lead and cadmium were less than 500 and 25 ppm, respectively, or until a maximum excavation depth of one foot was achieved. If concentrations exceeded the action level at the base of excavation, an artificial barrier was installed prior to backfill. Properties were backfilled with clean native soils and revegetated. Driveways were also replaced with limestone gravel if testing required removal of the chat used for the driveway. The same criteria were utilized for residential work at other OUs of the Site.

A total of 441 properties were sampled, and 47 yards have been remediated at the Baxter Springs subsite to date. The 1997 ROD for OU3/OU4 concludes that remediation of future residential development sites shall be the responsibility of the property owner or the responsible party. Since the completion of the residential aspect of the PRP response action, no additional residential properties have been remediated by the PRP.

The mine waste cleanup portion of the PRP response action included the removal of wastes from minor streams and drainages; draining and capping tailings impoundments; and grading, consolidating, and capping chat piles followed by revegetation of all disturbed areas. Approximately 160 acres and approximately 700,000 cubic yards of mining wastes were remediated at the Baxter Springs subsite by PRPs. The work was completed by 2003. The PRP portions of this OU are currently in the O&M phase.

The first phase of EPA fund-lead mine waste remedial design (RD) and RA addressed source materials in both the Baxter Springs and Treece subsites and was completed in 2012. After completion and during this FYR period, an issue at the Hessee-Lewis repository was identified by KDHE where a black material has surfaced and has impacted the vegetative cover. KDHE conducted a probe study in 2017 and identified highly acidic backfill that was unsuitable as a cover material for the capped mine wastes due to its erodibility and toxicity to the vegetative cover. The EPA conducted additional RD work based on the probe study results and is currently in a pre-final design phase. Additional RA work at this repository will be conducted with the remaining work from the second phase RA at the Sunflower Mine Complex.

The second phase mine waste RA, addressing source material only in the Baxter Springs subsite, began in 2011 and is still underway following contractor default. The contractor was tasked with remediation of one residential yard in 2012 in Baxter Springs. Due to the contractor default, the records related to work are unavailable. The EPA will confirm the current property status. The second phase RA work areas are undergoing a re-design due to a change in site conditions at the Sunflower Mine Complex. Following contractor default, the conditions of the work areas were largely unknown since available sampling records lacked geographic locations. The re-design was required to characterize the remaining contamination at the original work areas.

The third phase mine waste RA was completed in 2019 and addressed several hundred acres of source material. One residential drinking water well was addressed under an emergency removal action in 2018. The third phase RA included mine waste cleanup surrounding the PRP remedy at the Bruger shaft complex. Due to prior property access difficulties, the EPA was unable to adequately characterize the remaining mine waste and contaminated soil around the PRP remedy. Property ownership has since changed and allowed for remediation. The EPA addressed multiple subsidence features, mine shafts, and volumes of mine waste and contaminated soil. The EPA was unable to fully remediate the property due to the existing PRP remedy components at the Bruger shaft complex. The PRP remedy pre-dated the remedy components of the 2006 ROD Amendment.

The EPA is currently designing remaining areas from phase one, phase two, and other distal areas in the Baxter Springs subsite for a final RA planned to start in 2020/2021.

OU4 – Treece subsite

Many phases of work have been completed or are underway and being conducted by PRPs and the EPA at this subsite.

The first PRP response action consisted of a residential lead cleanup for the community of Treece, Kansas. The residential work at this OU was completed by PRPs under the same 1999 CD as the OU3 work described above. A total of 148 properties were tested and 41 yards were remediated. The residential cleanup was completed in 2000.

The EPA implemented a voluntary residential buy-out for the community of Treece, Kansas, that was conducted by KDHE. This work was specified in a 2010 ESD for the adjacent Tar Creek Superfund site in Oklahoma. Residential buy-outs for Oklahoma communities adjacent to Treece were historically conducted by EPA Region 6 and the state of Oklahoma. The influence of Oklahoma-based mining wastes upon the community of Treece lead to the modification of the EPA Region 6 Tar Creek ROD to address the impacts to Treece citizens. All buy-out activities in the community of Treece were concluded with the disbandment of the Treece Relocation Assistance Trust on May 22, 2014.

The PRP response action for non-residential mining wastes at the Treece subsite began in 2013. Three separate OU4 parcels were planned for remediation by three PRPs: Blue Diamond/Blue Mound, Jarrett, and Robinson. Two of the three PRPs either declared bankruptcy or settled their liability with a cash-out settlement. (See Appendix C, Peabody Energy and Blue Tee settlements.) The Robinson and Jarrett parcel RA was completed by the remaining PRP in 2019 and is undergoing O&M. The Blue Diamond/Blue Mound parcel was nearly completed with remaining activities of seeding, erosion repair, and fencing. This parcel is now fund-lead and is planned for RA in 2020 under an existing cooperative agreement with KDHE.

The EPA completed a mine waste RA in 2012 for several hundred acres in conjunction with the work described for the first phase RA for OU3 above. The second phase mine waste RA for OU 04 was completed in 2014. This phase included the remediation of the former city of Treece after the relocation actions were complete. As the city structures and roads were demolished, mine waste was encountered. The EPA removed the mine waste and contaminated soils in the former city limits, backfilled, and revegetated the area.

The third phase mine waste RD was split into five sub-phases A-E and encompasses Tar Creek and surrounding mine waste piles. The Phase IIIA RA started in 2017 and is nearing completion with revegetation activities. This RA included the northwest tributary of Tar Creek and surrounding mine waste areas.

The remaining sub-phase IIIB-E RD is currently in the preliminary design phase and is subject to revision based on the remedy decision at OU9 on the contaminated sediments in the perennial portion of Tar Creek. In 2020, the EPA completed an RD for a mine waste area along an unnamed tributary to Tar Creek, the Webber Mine Complex. The RA is planned to start in 2020. Remaining RA work along Tar Creek will be combined with OU9.

OU5 – Galena Groundwater/Surface Water

The EPA fund-lead work at this OU is in the O&M phase and is being conducted by KDHE. The remedy was started in 1993 and was completed in 1996. The response action consisted of a fund-lead mine waste cleanup of approximately 857 acres of non-residential land surrounding the community of Galena, Kansas. Mining wastes were segregated, and wastes less than 1,000 ppm lead were placed at the surface, with more impacted wastes placed at depth or used as fill material for open dry shafts. Low concentration wastes or bull rock were used to fill shafts that were water-filled. In general, large mine waste accumulations were regraded and redistributed; local drainages were enhanced by rip rap; new engineered drainages were created (geotextile lined with rip rap); open mine shafts and collapse features were filled with wastes; and the surface was revegetated following a series of inspections after completion of the remedy. OU5 transitioned to the O&M phase in 1997.

PRPs conducted a cleanup of the former Eagle-Picher smelter buildings and associated grounds pursuant to the terms of a 2006 bankruptcy settlement. (See Appendix C, Eagle-Picher settlement.) The decontamination work on the buildings and remediation of the surrounding land areas has been completed. The decontaminated buildings are currently being reused by a local business. These activities were managed and overseen by KDHE. All work was completed in 2014. There is no O&M associated with the PRP work at this OU.

Surface water monitoring in Short Creek has been conducted since March 2014 on a frequency of twice a month. This work is part of the larger surface water and sediment monitoring conducted by the EPA's Office of Research and Development (ORD) under an Interagency Agreement with the U.S. Geological Service (USGS). This work is in support of the ongoing RI at OU2 – Spring River Basin.

OU6 – Badger, Lawton, Waco, and Crestline subsites

Work at this OU has been conducted by the EPA and PRPs. Two CDs – one for the Waco subsite and one for the Crestline subsite – were completed, and the PRPs conducted response actions under these decrees. (See Appendix C, OU6 settlements.) The Badger and Lawton cleanups were conducted by the EPA as fund-lead RAs. All response work is complete, and the PRPs and the state of Kansas are conducting O&M activities.

Groundwater was sampled during the RI through the RA. To meet the RAOs at the subsites, the agency and the PRPs abandoned the identified mine-related and cased vent holes encountered during construction according to corresponding state requirements. Groundwater in the shallow aquifer (Boone) in the subsites was not used for a domestic source of drinking water. COC concentrations in the shallow aquifer were found to not exceed National Primary and Secondary Drinking Water Standards. Based on the findings and conclusions in the PRP RA reports, there were no plans to continue monitoring the shallow aquifer as a component of the remedy. Three shallow aquifer monitoring wells installed during the RI/FS (Grasselli-272, P4 NW, P15-E) for the Waco subsite were retained for potential use by the EPA or KDHE.

The following describes the status of each of the four OU 06 subsites.

Badger/Lawton subsites – The EPA completed the physical construction work under which approximately 680,000 cubic yards of wastes were addressed. Work at this subsite was combined with the Lawton subsite. At the Badger repository, the access road has undergone multiple iterations of repair due to recent flooding events. The Badger repository currently has some ponding on the repository cap

along the access road and needs soil amendments to promote adequate grass growth. These activities are being conducted by KDHE.

Waco subsite – The EPA and PRPs conducted response actions at this subsite. The PRP construction work was completed in 2012, and the EPA portion was completed in 2011. Approximately 975,000 cubic yards of wastes were addressed at the Waco subsite by the EPA and PRPs. The fund-lead repository at the Waco subsite was repaired by KDHE. The Site is currently in O&M.

Crestline subsite – The PRP RA is complete. The PRP conducted response actions at this subsite. (See Appendix C, OU6 Crestline settlement.) Approximately 250,000 cubic yards of wastes were addressed. This subsite is in the O&M phase.

OU7 – Galena Residential Soils

The remedy for OU7 has been completed. The remedial action included the excavation and disposal of residential soils impacted by mining wastes, and operation and maintenance of all remedy aspects. A lead level of 800 ppm or a cadmium level of 75 ppm triggered remediation of a residential property. All contaminated soil greater than 500 ppm lead or 25 ppm cadmium was excavated. No properties exceeded the cadmium levels to trigger remediation. All cleanup actions were triggered by their respective lead levels. The agency has recognized that the site-specific action level of 800 ppm for OU7 and other site OUs (OU3, 4, and 6) may not be protective due to current EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.

Remediation took place from May 12, 1997 to May 2001, and was divided in two phases. Phase I of the remediation efforts encompassed 274 properties. Phase II included 366 properties. The Removal Action predated the Remedial Action and included 62 properties, with a total of 702 properties addressed in Galena, Kansas, under Removal and Remedial Actions.

Treatability studies were proposed to be conducted concurrently with the excavation and disposal activities to determine whether phosphate treatment is a future viable option. A 1997 preliminary report for phosphoric acid treatment to reduce lead bioavailability in soils in Joplin, Missouri, was referenced in the site file. Further pilot scale studies performed at other sites have demonstrated that in the short-term, phosphate stabilization may reduce the bioavailability of lead by 30 to 50 percent in residential soils; however, it is only effective on lead concentrations less than 1,200 ppm. Its effectiveness on chat is unknown because chat is not a fine-grained material like residential soils. In addition, the use of phosphoric acid, which is the most effective for long term stabilization of lead, may cause increased short term leaching of zinc.

Although O&M activities do not include collection of environmental samples, to assess the effectiveness of the remedy, a follow-up blood lead study was conducted by KDHE, the local Cherokee County Health Department, and ATSDR in the community of Galena. The study was released in 2004 and illustrated the benefits of the completed residential cleanup by contrasting the results to an earlier ATSDR blood lead study conducted prior to the residential work. The geometric mean of blood lead levels in Galena children less than six years of age decreased from 4.13 µg/dl to 2.29 µg/dl following the residential cleanup.

This OU is in the O&M phase. The required ICs under the ROD as a part of the O&M program have not fully been implemented. A health program was previously funded by the EPA.

IC Summary Table

Several site documents include these county-wide ICs. While ICs were selected, there are issues with implementation and/or enforcement. Restrictions on the capped mine waste areas are in place for several repositories in OU3, OU4, and OU6 with the use of the KDHE Environmental Use Control (EUC) program. But for OU3 and OU4, restrictions and monitoring on new residential development in mine waste areas are not in place. The EPA has not confirmed whether deed restrictions still exist on the deeds at historically remediated properties with capped wastes. The health education program currently in place at the Cherokee County Health Department requires review of its applicability in meeting the EPA requirements in the site documents. An IC plan for the Site was historically developed but requires update to reflect current site needs.

Table 3: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents (from OU#)	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Health Education	Yes	Yes (OU3, 4, 5, 6, 7)	Sitewide	Create an Environmental Health Program which will include specific requirements governing development in mine waste areas	Cherokee County Health Department (1997)
Soil	Yes	Yes (OU3, 4, 5, 6, 7)	Sitewide	Control future residential development	County ordinance – planned, not yet implemented
Capped mine waste areas/residential yards	Yes	Yes (OU3, 4, 5, 6, 7)	Sitewide	Land use controls to protect the integrity of the capped mine waste or contaminated soil	Deed restrictions or Environmental Use Controls (per property) - ongoing

Chat/Mine Waste	No	Yes (OU3, 4)	Sitewide	Eliminate the use of chat mine waste as a surface material for all roads within Cherokee County	Resolution, Cherokee County Commission (2003)
Groundwater	No	Yes (OU3, 4, 5, 6)	Sitewide	Restrictions on the drilling and installation of new domestic water supply wells	Environmental Code, Cherokee County (1999)
Groundwater	Yes	Yes (OU3, 4, 5, 6)	Sitewide	Monitor construction, and implement design and construction standards for new deep wells in Cherokee County	Environmental Code, Cherokee County (1999)

Systems Operations/Operation & Maintenance

OU 01 - Galena Alternate Water Supply

Since completion of the OU1 remedial action in 1994, the RWD has been expanded to include more than 100 new residential hookups and is now under the oversight of the state of Kansas pursuant to its safe drinking water program. For example, activities implemented by the RWD include routine maintenance of wells, pumps, buildings, and construction activities to connect new users. There are no known problems with the operation of the RWD. The EPA considers the O&M complete and defers to Kansas to oversee its public water systems. Thus, further discussion of this OU1 is unnecessary for this FYR.

OU3 - Baxter Springs Subsite

Residential O&M: KDHE conducts O&M of the fenced soil repository located in Galena, Kansas. Land use controls such as deed restrictions were required for areas with waste left behind. The EPA has not confirmed whether deed restrictions still exist on the deeds at historically remediated properties with capped wastes.

Non-residential O&M: Inspection, monitoring, and repair of soil cap erosion problems and maintenance of vegetative growth on the cap are performed by PRPs, along with surface water and sediment monitoring in the work areas. For the fund-lead areas, KDHE has assumed O&M on individual soil repositories when EPA construction and the operational and functional period are complete.

Based on the review of the Cherokee County Health Department website, the department offers blood lead testing for children by appointment. The health education program currently in place at the Cherokee County Health Department requires review on its applicability in meeting the EPA requirements in the site documents.

Restrictions on the capped mine waste areas are in place for several repositories in OU3 with the use of the KDHE EUC program. Inspections of non-residential properties with land use restrictions are done periodically by KDHE and the EPA. But restrictions on new residential development in mine waste areas are not in place. The EPA has not confirmed whether deed restrictions still exist on the deeds at historically remediated properties with capped wastes.

For the groundwater ICs, the KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code. KDHE and the EPA will review records related to the ongoing implementation and enforcement of this IC to assure its effectiveness in meeting the groundwater RAOs. Records were not readily available during this FYR period.

OU4 - Treece Subsite

Non-residential O&M: The same activities as described for OU3 above. The existing PRP is conducting O&M activities on the repositories at the Jarrett and Robinson parcels. The remaining repository areas that are fund-lead are in O&M with KDHE.

Based on the review of the Cherokee County Health Department website, the department offers blood lead testing for children by appointment. The health education program currently in place at the Cherokee County Health Department requires review on its applicability in meeting the EPA requirements in the site documents.

Restrictions on the capped mine waste areas are in place for several repositories in OU4 with the use of the KDHE EUC program. Inspections of non-residential properties with land use restrictions are done periodically by KDHE and the EPA. But restrictions on new residential development in mine waste areas are not in place. Any previous deed restrictions on properties at the former city of Treece would no longer apply following the buyout.

For the groundwater ICs, the KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code. KDHE and the EPA will review records related to the ongoing implementation and enforcement of this IC to assure its effectiveness in meeting the groundwater RAOs. Records were not readily available during this FYR period.

OU5 - Galena Groundwater/Surface Water

Non-residential O&M: The same activities as described for OU3 above. Specifically the O&M for OU5 is focused on the lined channels and maintenance of vegetated cover to assure a stabilized cover and to control erosion. KDHE has been periodically mowing existing vegetative cover to promote adequate cover. There are still many areas in OU5 that lack sufficient vegetation to control erosion. This includes steeply sloped locations, highly acidic areas, and locations with insufficient organic materials that are difficult to revegetate or maintain an adequate stand of vegetation. KDHE has attempted the use of various soil amendments over the last five years to promote grass growth.

Since the OU5 RAs have been completed, post-remediation data collection and site inspections have indicated that surface soils exceed lead and zinc action levels. KDHE has continued their O&M efforts as specified in the ROD. However, there are areas of the Site not maintained under CERCLA O&M requirements that have remained devoid of vegetation and have subsidence features.

Surface water monitoring has been conducted by the EPA (ORD) since 2014 with continuous monthly monitoring within the Galena subsite. This monitoring is in support of the RI/FS activities of OU2. KDHE continues to conduct surface water monitoring on Short Creek and Shoal Creek under their Total Maximum Daily Load (TMDL) program.

Based on the review of the Cherokee County Health Department website, the department offers blood lead testing for children by appointment. The health education program currently in place at the Cherokee County Health Department requires review on its applicability in meeting the EPA requirements in the site documents.

Restrictions on the capped mine waste areas are not currently in place for the non-residential capped wastes in OU5. Inspections of non-residential properties with land use restrictions are done periodically by KDHE and the EPA. But restrictions on new residential development in mine waste areas are not in place. The EPA has not confirmed whether deed restrictions existed historically on the deeds at historically remediated properties with capped wastes. The EPA and KDHE will pursue the use of KDHE's EUC program for future land use controls in OU5.

For the groundwater ICs, the KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code. KDHE and the EPA will review records related to the ongoing implementation and enforcement of this IC to assure its effectiveness in meeting the groundwater RAOs. Records were not readily available during this FYR period. A records search in the EPA site file is ongoing. The EPA is actively working with the state and local health departments on requests for relevant records.

OU6 - Badger, Lawton, Waco, and Crestline Subsites

Residential and non-residential O&M: The same as described for OU3 above. There are repositories under PRP-lead O&M and fund-lead O&M. PRP-lead O&M is ongoing with as-needed repair of repository damage and inspections with reporting. Annual inspections at the Crestline subsite are conducted by the PRP with EPA and KDHE attendance. No major issues related to the existing remedy have been reported during this FYR period except for the ongoing monitoring of the expanding subsidence feature at the Ellis Repository.

During the winter of 2013 to 2014, a subsidence feature in the Crestline subsite appeared directly adjacent to the Ellis Repository, which is undergoing PRP-lead O&M. It has since been growing outward and in a northwest direction toward the capped wastes. The EPA and the PRPs have ongoing discussions on the subsidence and its potential future impacts to the repository. The EPA and the PRPs will continue to monitor the subsidence.

The agency has not received reporting related to the PRP-lead O&M at the Waco subsite. A records search in the agency files did not yield any O&M reporting following the RA completion in 2012. The EPA will address the issue of ongoing O&M and confirm land use restrictions on the property.

Based on the review of the Cherokee County Health Department website, the department offers blood lead testing for children by appointment. The health education program currently in place at the Cherokee County Health Department requires review on its applicability in meeting the EPA requirements in the site documents.

Restrictions on the capped mine waste areas are not currently in place for all the non-residential capped wastes in OU6. Inspections of non-residential properties with land use restrictions are done periodically by KDHE and the EPA. But restrictions on new residential development in mine waste areas are not in place. The EPA has not confirmed whether deed restrictions existed historically on the deeds at historically remediated properties with capped wastes. The EPA and KDHE will pursue the use of KDHE's EUC program for remaining, future land use controls in OU6.

For the groundwater ICs, the KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code. KDHE and the EPA will review records related to the ongoing implementation and enforcement of this IC to assure its effectiveness in meeting the groundwater RAOs. Records were not readily available during this FYR period.

OU7 - Galena Residential Soils

Residential O&M: The same as described for OU3.

Based on the review of the Cherokee County Health Department website, the department offers blood lead testing for children by appointment. The health education program currently in place at the Cherokee County Health Department requires review on its applicability in meeting the EPA requirements in the site documents.

The EPA has not confirmed whether deed restrictions existed historically on the deeds at historically remediated properties with capped wastes. Restrictions on new residential development in mine waste areas are not in place. The EPA and KDHE will pursue the use of KDHE's EUC program for future land use controls in OU7.

For the groundwater ICs, the KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code. KDHE and the EPA will review records related to the ongoing implementation and enforcement of this IC to assure its effectiveness in meeting the groundwater RAOs. Records were not readily available during this FYR period.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR, as well as the recommendations from the last FYR and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2015 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The remedy at OU 01 is protective of human health and the environment.
3	Will be Protective	The remedy at OU 03 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks.

4	Will be Protective	The remedy at OU 04 is expected to be protective of human health and the environment upon completion. In the interim, remedial actions completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in these areas.
5	Short-term Protective	The OU 05 remedy currently protects human health and the environment because highly contaminated soils have been excavated from residential and non-residential properties. However, in order to be protective in the long term, O&M enhancements to 200 acres of steep terrain and/or areas with low nutrient soils need to be implemented to reduce O&M costs and promote vegetation growth.
6	Protective	The remedy at OU 06 is protective of human health and the environment.
7	Protective	The remedy at OU 07 is protective of human health and the environment.

Table 5: Status of Recommendations from the 2015 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
5	Assess vegetation and engineering enhancements at portions of the completed OU5 remedy.	Continue assessing various amendments for use in optimally establishing vegetation and assessing engineering enhancements for portions of the completed OU 05 remedy.	Addressed in Next FYR	KDHE has regularly applied and assessed different amendments and conducted soil testing to identify necessary amendments for revegetation.	N/A

Recommendation 1

The EPA and KDHE have continued discussions and research into amendments and engineering enhancements for use in optimally establishing vegetation at portions of the completed OU5 remedy. These discussions are ongoing, and this issue is carried forward in this FYR.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a newspaper posting in the Columbus News-Report on 10/15/2019, stating that there was a FYR and inviting the public to submit any comments to the EPA. No public comments were received. The results of the review and the report will be made available at the site information repository located at: https://www.epa.gov/superfund/cherokeecounty.

No site interviews were conducted for this FYR. With the upcoming construction work, there is routine and consistent communication with the public. Additional public outreach activities are planned prior to the start of construction work planned for early 2021.

Data Review

Data from the OU1, OU3, OU4, OU5, OU6, and OU7 remedies are available for review in RA reports and contract completion documents.

For OU5, surface water and sediment samples collected by the EPA ORD from Short Creek were reviewed for this FYR. Samples collected from Short Creek from 2014 to 2016 detected cadmium and zinc above the surface water PRGs in every sample. Lead was detected above the PRG in one sample collected in 2016 (43.9 micrograms per liter [µg/L]). Results of dissolved zinc and cadmium have a high range of variability of 1,010 µg/L to 10,900 µg/L and 4.8 µg/L to 42.3 µg/L, respectively. The dissolved lead was consistently below the PRG with the exception of the 2016 sample. These concentrations are generally lower than concentrations identified in the OU5 RI but some are near the RI concentrations found in Short Creek.

Since the remedy at OU3 and OU4 is under construction, environmental data is collected and analyzed to determine whether site cleanup levels have been met. Data is evaluated as it is collected during ongoing RA actions. Completed work areas in OU3 and OU4 are inspected routinely by the EPA and KDHE to identify any remaining risks or changes in land use.

New residential development has been occuring in the Galena subsite. The OU5 remedy does not adequately address the potential future residential development of the OU5 work areas. The OU5 action levels are not protective for residential use, using the site-specific action level of 800 ppm for the Galena subsite for OU7. There are likely properties that have been developed for residential use since the completion of the RA in 1995 that may have surface metals concentrations exceeding the OU7 action and cleanup levels for residential use. Furthermore, the site-specific action level of 800 ppm for OU7 and other site OUs (OU3, 4, and 6) may not be protective due to current EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.

The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple “constructed” domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

There is a current effort to compile the historic data sitewide into a database to allow for future data review. A more systematic approach to identifying change in land use and well use will be incorporated in an updated sitewide IC plan.

Site Inspection

The inspection of the Site was conducted on March 10-11, 2020. In attendance were Elizabeth Hagenmaier, EPA; Venessa Madden, EPA; Preston Law, EPA; and Chris Hase, KDHE. The purpose of the inspection was to assess the protectiveness of the remedy.

On March 10, 2020, the EPA assessed the current conditions at several areas throughout the Site. The group visited remediated non-residential properties in OU3, OU4, and OU5. Several areas were walked for a review of site conditions including vegetation, drainage, and the presence of mine waste. The OU5 properties had visible mine waste, bare areas, spotty vegetation, and erosional features. OU3- and OU4-remediated non-residential properties appeared in good condition except for a repository completed under the OU3 Phase I RA, the Hessee-Lewis repository. This repository had black material and a lack of vegetation along the north side of the repository, adjacent to the road.

On March 11, 2020, the EPA and KDHE reviewed OU6 repositories that recently had undergone repair. The Waco repository was inaccessible for inspection due to new locks on the gate. At the Badger repository, drainage issues were identified on the top of the repository due to a ponded area. Other issues that were identified were sparse vegetation on the slopes and vegetation with gaps greater than nine inches.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

Except as noted below, the remedies for OUs 3, 4, 6 and 7 generally are functioning as intended for the non-residential remedial actions completed to date. However, there are issues of required monitoring of soils and groundwater, potential new wells, and residential yards in the Site at OUs 3, 4, 5, 6, and 7 and ICs at the Site that are not being implemented or enforced. OU5 is not functioning as intended due to the elevated COCs in the soil and surface water and the lack of implementation and/or enforcement of the ICs. O&M is ongoing at some OUs and on specific repositories within the Site.

Remedial Action Performance

OU3 - Baxter Springs Subsite:

- *Prevent exposure to impacted source materials, soils, surface water, and sediment.*
  The PRP-lead remedial action addressing the OU3 source materials was completed by 2000. (See Appendix C, OU4 Baxter Springs settlements.) EPA-lead remedial actions addressing the mine waste and non-residential soils began in 2008. Millions of cubic yards of wastes have been removed from thousands of acres of land at OU3, and cleanup levels were achieved for all source materials (soils, mine waste, and sediments) that have been addressed. An identified repository issue resulting from highly acidic backfill at the Hessee-Lewis property will be addressed under an ongoing remedial action at OU3. The remedy is expected to take another three to four years to complete. ICs in place continue to address and limit land use on capped mine waste areas.

- *Prevent exposure to contaminated residential yard soils for OU3*.
  The PRP-lead remedial action addressing the OU3 residential yards was completed by 2003. A total of 441 properties were tested, 46 properties were remediated and 3 property owners declined access for remediation. The EPA has historically addressed requests for individual property information upon request. No formal county-wide database exists to allow for public review and awareness. The potential for future residential yard remediation has only been addressed on a case-by-case basis between the EPA and KDHE.

The agency has recognized that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to changed EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm. The non-residential cleanup levels in OU3 are protective for future residential development and could be applied to a residential property, as needed. This clarification may be reviewed as a follow-up to this FYR under a remedy change document.

- *Prevent exposure to contaminated groundwater*.
  The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

- *Protect the deep aquifer during remedy implementation.*
  The RWD is required to conduct regular sampling and publishes the results online for public review. No violations were recorded in the RWDs in the Site for 2019, but the available reporting did not include results for all site COCs such as cadmium and lead. The agency will request additional information prior to making a protectiveness determination at OU3.

  The existing or future wells drilled through the impacted uppermost aquifer and its underlying confining unit may contaminate the deep aquifer, which is a primary water source. Except for the limitation on domestic well drilling in the Cherokee County Environmental Code, established as a component of OU5, no restrictions or controls on drilling in Cherokee County are readily identified on the Kansas Department of Health and Environment Water Well, Kansas Geological Survey, Kansas Rural Water Association, or Cherokee County Health Department websites.

OU4 - Treece Subsite:

- *Prevent exposure to impacted source materials, soils, surface water, and sediment.*
  EPA-lead remedial actions addressing the mine waste and soils began in 2008. The PRP-lead remedial action began in 2013 and was completed in 2019. (See Appendix C, OU4 Treece settlements.) Millions of cubic yards of wastes have been removed from thousands of acres of land at OU4, and cleanup levels were achieved for all source materials (soils, mine waste, and sediments) that have been addressed. The remedy is expected to take another eight to ten years to complete. ICs in place continue to address and limit land use on capped mine waste areas.

- *Prevent exposure to contaminated residential yard soils for OU4*.
  The PRP-lead remedial action addressing the OU4 residential yards was completed by 2000. (See Appendix C, OU4 Treece settlements.) A total of 148 properties were tested and 41 properties were remediated. Treece was then subject to a permanent relocation that left only two residences within the former city limits. Throughout the subsite, the EPA has historically addressed requests for individual property information upon request. No formal county-wide database exists to allow for public review and awareness. The potential for future residential yard remediation has only been addressed on a case-by-case basis between the EPA and KDHE.

The agency has identified that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to changed EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm. In OU4, only two residential properties remain in the former city of Treece. This issue may arise with any future residential development in the remaining mine waste areas. The non-residential cleanup levels in OU4 are protective for future residential development and could be applied to a residential property as needed. This clarification may be reviewed as a follow-up to this FYR under a remedy change document.

- *Prevent exposure to contaminated groundwater*.
  The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

- *Protect the deep aquifer during remedy implementation.*
  The RWD is required to conduct regular sampling and publishes the results online for public review. No violations were recorded in the RWDs in the Site for 2019, but the available reporting did not include results for all site COCs such as cadmium and lead. The agency will request additional information prior to making a protectiveness determination at OU4.

  The existing or future wells drilled through the impacted uppermost aquifer and its underlying confining unit may contaminate the deep aquifer, which is a primary water source. Except for the limitation on domestic well drilling in the Cherokee County Environmental Code, established as a component of OU5, no restrictions or controls on drilling in Cherokee County are readily identified on the Kansas Department of Health and Environment Water Well, Kansas Geological Survey, Kansas Rural Water Association, or Cherokee County Health Department websites.

OU5 - Galena Groundwater/Surface Water:

- *Reduce risks associated with exposure to soil, surface water, and groundwater contaminants.*
  The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

  The OU5 remedy may not be functioning as intended for reducing risks associated with exposure to surface water. Surface water monitoring results from 2014 to 2016 indicate consistent exceedances above the PRGs for zinc and cadmium. At least one sample in 2016 was elevated for lead in surface water.

  The OU5 remedy is functioning as intended where implementation included actions to divert and rechannel certain surface drainages, and recontouring the ground surface to the extent possible. These actions were intended to reduce recharge to the shallow groundwater system, reduce infiltration through the cover material, and promote proper surface drainage and control erosion. However, the implementation of these actions may not have not been effective in reducing surface water metal contamination. There are surface metal concentrations that exceed the action

levels, and many areas do not have an adequate vegetative cover. These have contributed to erosion issues in OU5. For exposure to groundwater via its interaction with surface water, multiple lines of evidence (e.g., USGS investigations, Kansas TMDL publications, the depth to the shallow groundwater aquifer, the overlying shale/nonyielding limestone) indicate that significant surface water metal contamination comes from mine waste and not shallow groundwater (USEPA, 2006b; USGS, 2005).

The OU5 remedy does not adequately address the potential future residential development of these areas. The OU5 action levels are not protective for residential use, using the site-specific action level of 800 ppm for the Galena subsite for OU7. There are likely properties that have been developed for residential use since the completion of the RA in 1995 that may have surface metals concentrations exceeding the OU7 action and cleanup levels for residential use.

The OU5 remedy does not adequately address the health risks associated with exposure to COCs in the shallow groundwater. The 1989 ROD concluded that there may be continued health risks associated with ingestion of the shallow groundwater in the subsite. The 1989 ROD had an alternative remedial strategy to address source and exposure controls to accompany the TI waiver on the shallow aquifer. Although source control has been implemented, the exposure control component of the alternative remedial strategy relies on ICs. Except for the limitation on domestic well drilling in the Cherokee County Environmental Code, established as a component of OU5, no restrictions or controls on drilling new domestic wells in Cherokee County are readily identified on the Kansas Department of Health and Environment Water Well, Kansas Geological Survey, Kansas Rural Water Association, or Cherokee County Health Department websites. The current enforcement and continued applicability of the Cherokee County Environmental Code is unknown. The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

- *Protect the deep aquifer and enhance surface water quality.*
  The RWDs are required to conduct regular sampling and publish the results online for public review. No violations were recorded in the RWDs in the Site for 2019, but the available reporting did not include results for all site COCs such as cadmium and lead. The agency will request additional information prior to making a protectiveness determination at OU5.

  The existing or future wells drilled through the impacted uppermost aquifer and its underlying confining unit may contaminate the deep aquifer, which is a primary water source. Except for the limitation on domestic well drilling in the Cherokee County Environmental Code, established as a component of OU5, no restrictions or controls on drilling in Cherokee County are readily identified on the Kansas Department of Health and Environment Water Well, Kansas Geological Survey, Kansas Rural Water Association, or Cherokee County Health Department websites. The KDHE Bureau of Water provides the oversight and enforcement of the Cherokee County Environmental Code.

OU6 - Badger, Lawton, Waco, and Crestline Subsites:

- *Prevent exposure to impacted soils, source materials, surface water, sediments, and groundwater.*

Remedial actions addressing the source materials, impacted soils, and sediments were completed in 2012. Thousands of cubic yards of wastes have been removed from hundreds of acres of land at OU6, and cleanup levels were achieved for all source materials (soils, mine waste, and sediments) that have been addressed. ICs in place continue to address and limit land use on capped mine waste areas. Throughout the subsites, the EPA has historically addressed requests for individual property information upon request. No formal county-wide database exists to allow for public review and awareness. The potential for future residential yard remediation has only been addressed on a case-by-case basis between the EPA and KDHE.

The agency has identified that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to changed EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.

Groundwater was sampled during the RI through the RA. To meet the RAOs at the subsites, the agency and the PRPs abandoned the identified mine-related and cased vent holes encountered during construction according to corresponding state requirements. Groundwater in the shallow aquifer (Boone) in the subsites was not used for a domestic source of drinking water. COC concentrations in the shallow aquifer were found to not exceed National Primary and Secondary Drinking Water Standards. Based on the findings and conclusions in the PRP RA reports, there were no plans to continue monitoring the shallow aquifer as a component of the remedy. Three shallow aquifer monitoring wells installed during the RI/FS (Grasselli-272, P4 NW, P15-E) were retained for potential use by the EPA or KDHE.

The RWDs are required to conduct regular sampling and publish the results online for public review. No violations were recorded in the RWDs in the Site for 2019, but the available reporting did not include results for all site COCs such as cadmium and lead. The agency will request additional information prior to making a protectiveness determination at OU6. The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

OU7 - Galena Residential Soils

- *Reduce public exposure, and particularly children's exposure, to residential soils with elevated lead and cadmium resulting from past mining, milling, and smelting activities.*
  The remedial action is complete for OU7. Soil cleanup levels as established in the ROD were achieved at properties addressed during this OU's cleanup. The original soil repository is closed. Throughout the subsite, the EPA has historically addressed requests for individual property information upon request. No formal county-wide database exists to allow for public review and awareness. The potential for future residential yard remediation has only been addressed on a case-by-case basis between the EPA and KDHE.

  The agency has recognized that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to changed EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency

will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Question B Summary:

Human Health Risk

The cleanup level selected for various Cherokee County OUs was derived based on the 1994 and/or 1998 soil lead guidance documents (USEPA, 1994, 1998), which identify 10 µg/dL as the blood lead level of concern. However, since those documents were issued, increasing evidence has shown that blood lead levels below 10 µg/dL may also have negative health impacts. Specifically, the 2012 National Toxicology Program's (NTP) Monograph on Health Effects of Low-Level Lead (NTP, 2012) found sufficient evidence of effects on cognitive measures and behavior at blood lead levels below 5 µg/dL. If the blood lead level of concern is revised to a value less than 10 µg/dL, the resulting cleanup levels for lead based on human health risks to a child receptor would be lower than the values currently listed in the various Cherokee County RODs.

The agency has recognized that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to changed EPA policy and guidance related to remediation of lead-contaminated residential yards. The agency will review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.

Ecological Risk

Remedial action levels based on ecological risk were established for OUs 3 and 4 (soil) and OU6 (sediment). The levels established for soil at OUs 3 and 4 are based on potential risk to birds and mammals (10 ppm cadmium, 400 ppm lead and 1,100 ppm zinc). Because these levels were developed using site-specific exposure data and sensitive ecological receptors, they are considered protective of the terrestrial ecosystem overall.

The remedial action levels for sediment at OU6 are based on TECs (MacDonald et al., 2000), and are protective, as the TEC represents a threshold below which ecological effects are not expected to occur. Alternatively, background sediment concentrations were used pending approval by the EPA Region 7, KDHE and the U.S. Fish and Wildlife Service.

The remedial action levels for mine waste at OU5, and residential soil at OU7, were based on human health risks and exceed the ecological remedial action levels established for other OUs within Cherokee County. Lead in residential soil is typically evaluated for ecological risk based on common backyard species, such as the American Robin. Risk calculations for the robin indicate that lead concentrations below 400 ppm are protective. However, zinc in residential soil is evaluated based on phytotoxicity. A remedial action level for zinc at OU7 was not established. The protectiveness of the zinc remedial action levels for OU5 are uncertain. If mine waste and contaminated soil with elevated zinc concentrations remain at the Site, there is a high likelihood of phytotoxicity and toxicity to other ecological receptors, and revegetation of these areas will be challenging.

Changes in Standards and TBCs

For lead in soil, the EPA's Office of Solid Waste and Emergency Response Directives 9355.4-12 (EPA, 1994) and 9200.4-27P (EPA, 1998) were identified as federal chemical-specific To Be Considered guidance documents. However, since 1994 and 1998 when those documents were issued, increasing evidence has shown that blood lead levels below 10 µg/dL may also have negative health impacts. However, the 2012 NTP monograph found sufficient evidence of effects on cognitive measures and behavior at blood lead levels below 5 µg/dL.

More specifically, the NTP monograph concluded, "*In children*, there is *sufficient* evidence that blood Pb levels <5 µg/dL are associated with increased diagnosis of attention-related behavioral problems, greater incidence of problem behaviors, and decreased cognitive performance as indicated by (1) lower academic achievement, (2) decreased intelligence quotient, and (3) reductions in specific cognitive measures." These neurological effects are significant at both the population and individual level, because lower class rank and lower standardized achievement test scores have been reported in multiple prospective and cross-sectional studies of children with blood Pb levels <5 µg/dL. Further, the NTP found "*sufficient* evidence that blood Pb levels <5 µg/dL are associated with antisocial behavioral problems or actual criminal behavior in children from 6 to 15 years of age." For adults, the NTP found "*sufficient* evidence that blood Pb levels <5 µg/dL are associated with decreased renal function" and "*sufficient* evidence that maternal blood Pb levels <5 µg/dL are associated with reduced fetal growth." Although the evidence was less strong, the NTP also found associations of blood Pb levels <5 µg/dL with delayed puberty and decreased kidney function in children, and with essential tremor in adults. Overall, the objective of the NTP's monograph was to determine the degree of evidence for adverse health effects at blood lead levels of 5 µg/dL and at 10 µg/dL; as described, they found sufficient evidence of many different types of health effects at both levels that were examined.

The EPA's 2013 Integrated Science Assessment (ISA) for Lead states, "It is clear that Pb exposure in childhood presents a risk; further, there is no evidence of a threshold below which there are no harmful effects on cognition from Pb exposure." While the ISA reports, "Clear evidence of cognitive function decrements (as measured by Full Scale IQ, academic performance, and executive function) in young children (4 to 11 years old) with mean or group blood Pb levels measured at various life stages and time periods between 2 and 8 µg/dL," it is critical to note that there is not a threshold for toxicity somewhere between blood lead levels of 2 and 8 µg/dL. Rather, a "threshold for cognitive function decrements is not discernable from the available evidence." Although there are a greater number of studies available to support significant effects at 5 µg/dL, significant cognitive function decrements in children have been found at all levels examined, currently down to 2 µg/dL.

The cleanup levels for the Cherokee County Site were derived based on the 1994 and 1998 lead guidance documents, which identify 10 µg/dL as the blood lead level of concern. If the blood lead level of concern is revised to a value less than 10 µg/dL, the resulting cleanup levels for lead would be lower than the values currently listed in the Cherokee County RODs.

Finally, surface water RAOs for OUs 3 and 4 specify the prevention of ecological risks by reducing exposures related to metals-contaminated surface water. The National Ambient Water Quality Criteria for cadmium was updated in 2016. The 2001 cadmium criteria, based on a hardness of 100 milligrams per liter (mg/L) calcium carbonate, was 0.25 µg/L, and the 2016 criteria based on a hardness of 100 mg/L calcium carbonate is 0.72 µg/L. The 2016 cadmium criteria is higher; therefore, the change does not impact the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

Other than lead, for which increasing evidence supports a lower blood lead level of concern than was used at the time of the Cherokee County RODs, toxicity values for the other site COCs have not changed in a way that would significantly impact the selected remedies.

Changes in Risk Assessment Methods

Changes in risk assessment methodology have occurred since the risk assessments were conducted for the various Cherokee County OUs. The IEUBK model and Adult Lead Methodology (ALM) have been updated since many of the human health risk assessments were conducted, including the input parameters to the IEUBK model and ALM. In addition, the current methodology used to assess exposure and risks via the inhalation pathway changed in 2009 (USEPA, 2009), and the EPA completed an update of standard default exposure factors in 2014 (USEPA, 2014). Thus, many of the exposure assessment input parameters in the original risk assessments are different than values currently recommended. Despite these changes, they do not have a significant impact on the conclusions of the risk assessments.

The RODs for OUs 5 and 7 pre-date Superfund's Ecological Risk Assessment Guidance for Superfund (USEPA, 1997). This may impact the protectiveness of the remedies, particularly at OU5, where areas surrounding the town of Galena, not just residential yards, were remediated but where limited revegetation is occurring.

Changes in Exposure Pathways

The EPA has identified properties that were remediated under OU5 but have since been developed as commercial and residential properties. It is likely that some OU5-remediated properties have been developed for residential use, which would change the exposure pathway of an individual property to residential. The EPA is currently addressing this scenario to determine whether OU5 action levels would apply or whether OU7 action levels would apply to that particular property.

The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

The EPA is not aware of any other changes in land use, routes of exposure, contaminants, toxic byproducts, or physical site conditions that could impact the protectiveness of the remedy.

QUESTION C: Has any **other** information come to light that could call into question the protectiveness of the remedy?

The agency reviewed the Kansas Geological Survey Water Well Completion Records database for Cherokee County, and identified multiple "constructed" domestic wells with relatively shallow open intervals within the site boundary. Whether these wells remain active and whether the well owners/users are aware of associated health risks and opportunities for sampling and alternate water supplies is unclear.

The EPA is not aware of any additional information that could impact the protectiveness of the remedy at this time.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
N/A

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU3, OU4, OU5, OU6	**Issue Category: Remedy Performance**			
	Issue: Domestic wells may persist within the site boundary that may be drilled through the impacted upper aquifer and may contaminate the lower aquifer.			
	Recommendation: Identify existing domestic wells within the site boundary, test any identified domestic wells, and plug any wells that may be impacting the lower aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU3, OU4, OU5, OU6, OU7	**Issue Category: Remedy Performance**			
	Issue: Drinking water supply wells may exist within the site boundary that require sampling and/or remediation.			
	Recommendation: Identify new drinking water supply wells within the site boundary, test any identified drinking water supply wells, and address any impacted wells.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU3, OU4, OU6, OU7	Issue Category: Remedy Performance			
	Issue: New residential development may exist within the site boundary that requires sampling and/or remediation.			
	Recommendation: Identify new residential development within the site boundary, test any identified residential yards, and address any impacted residential yards.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU3, OU4, OU6, OU7	Issue Category: Remedy Performance			
	Issue: The agency has recognized that the site-specific action level of 800 ppm for the residential remedy component in the site OUs (OU3, 4, 6, 7) may not be protective due to current EPA policy and guidance related to remediation of lead-contaminated residential yards.			
	Recommendation: Review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU5	Issue Category: Remedy Performance			
	Issue: The protectiveness of lead and zinc remedial actions levels for OU5 is uncertain. And there is a high likelihood of human health and ecological risk due to high lead and zinc concentrations at the Galena subsite.			
	Recommendation: Evaluate the risks to aquatic life, terrestrial life, and human health at the Galena subsite and develop recommendations.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU7	Issue Category: Remedy Performance			
	Issue: A remedial action level for zinc at OU7 was not established, and remaining soils may exceed levels protective of ecological receptors.			
	Recommendation: (1) Evaluate the phytotoxicity of these areas to develop recommendations for revegetation; and (2) determine whether additional actions are needed to remediate remaining soils with potentially elevated zinc levels.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU3, OU4, OU5, OU6, OU7	Issue Category: Institutional Controls			
	Issue: The required county-wide ICs are not fully implemented or enforced.			
	Recommendation: Establish a systematic approach to implement and review site ICs under an updated county-wide IC plan.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OU(s): OU3, OU4, OU5, OU6, OU7	Issue Category: Operations and Maintenance			
	Issue: O&M activities and monitoring of the implemented ICs and remedy components are not being fully completed in accordance with the RODs for each OU.			
	Recommendation: Revise and/or create O&M plans for each OU to address current O&M needs as required by the RODs for each OU.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State	EPA/State	9/30/2022

OTHER FINDINGS

In addition, the following are recommendations identified during the FYR, but that do not affect current and/or future protectiveness:

- There have been some changes to the current Centers for Disease Control and Prevention acceptable reference value blood lead concentrations to be protective for child blood lead levels. Region 7 will examine the need to revise the soil cleanup levels based on the Centers for Disease Control recommendations and determine whether additional actions should be taken to further reduce the risk of future elevated blood lead levels in young children at the Site.
- An additional recommendation is to develop or more broadly distribute rules and best practices to avoid contamination of the lower aquifer drinking water in areas where the upper aquifer is contaminated.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: OU3, OU4, OU6	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2022
Protectiveness Statement: The protectiveness of the remedies at OU3, OU4, and OU6 cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions: (1) identify existing domestic wells within the site boundary, test any identified domestic wells and plug any wells that may be impacting the lower aquifer; (2) establish a systematic approach to implement and review site ICs under an updated county-wide IC plan; (3) revise and/or create O&M plans for each OU to address current O&M needs as required by the RODs for each OU; (4) identify new drinking water supply wells within the site boundary, test any identified drinking water supply wells, and address any impacted wells; (5) identify new residential development within the site boundary, test any identified residential yards, and address any impacted residential yards; and (6) review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm.		

Protectiveness Statement(s)		
Operable Unit: OU5	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2022
Protectiveness Statement: The protectiveness of the remedy at OU5 cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions: (1) identify existing domestic wells within the site boundary, test any identified domestic wells, and plug any wells that may be impacting the lower aquifer; (2) establish a systematic approach to implement and review site ICs under an updated county-wide IC plan; (3) revise and/or create O&M plans for each OU to address current O&M needs as required by the RODs for each OU; (4) identify new drinking water supply wells within the site boundary, test any identified drinking water supply wells, and address any impacted wells; and (5) evaluate the risks to aquatic life, terrestrial life, and human health at the Galena subsite and develop recommendations.		

Protectiveness Statement(s)		
Operable Unit: OU7	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2022
Protectiveness Statement: The protectiveness of the remedy at OU7 cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions: (1) establish a systematic approach to implement and review site ICs under an updated county-wide IC plan; (2) revise and/or create O&M plans for each OU to address current O&M needs as required by the RODs for each OU; (3) identify new drinking water supply wells within the site boundary, test any identified drinking water supply wells, and address any impacted wells; (4) identify new residential development within the site boundary, test any identified residential yards, and address any impacted residential yards; (5) review available residential yard data and address the protectiveness of the historic action level of 800 ppm and the historic cleanup level of 500 ppm; and (6) evaluate the phytotoxicity of these areas to develop recommendations for revegetation, and determine whether additional actions are needed to remediate remaining soils with potentially elevated zinc levels.		

VIII. NEXT REVIEW

The next FYR report for the Cherokee County Superfund Site is required five years from the completion date of this review.

APPENDIX A

REFERENCE LIST

REFERENCE LIST

Cherokee County. 1999. Cherokee County, Kansas, Environmental Code / Sanitary Code. http://www.kdheks.gov/nps/lepp/county_codes/CherokeeCounty.pdf

MacDonald, D.D., Ingersoll, C.G., Berger, T.A. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Env. Toxicol.* 39:20-31.

NTP. 2012. National Toxicology Program Monograph on Health Effects of Low-Level Lead. National Institute of Environmental Health Sciences. June.

USEPA. 1987. Record of Decision. Cherokee County Superfund Site. Galena subsite. Alternate Water Supply Operable Unit. Cherokee County, Kansas.

USEPA. 1989. Record of Decision. Cherokee County Superfund Site. Galena Sub-site Groundwater/Surface Water Operable Unit. Cherokee County, Kansas.

USEPA. 1989. Explanation of Significant Differences. Galena subsite. Alternate Water Supply. Cherokee County Superfund Site. Cherokee County, Kansas.

USEPA. 1993. Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, DC. OSWER Publication 9234.2-25. September.

USEPA. 1994. Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9355.4-12. August.

USEPA. 1996. Record of Decision. Cherokee County Superfund Site. Galena Residential Soils/Operable Unit 7. Cherokee County, Kansas.

USEPA. 1997. Record of Decision. Cherokee County Superfund Site. Baxter Springs and Treece subsites/Operable Units 3 and 4. Cherokee County, Kansas.

USEPA. 1998. Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, DC. OSWER Directive 9200.4-27. August.

USEPA. 2001. Comprehensive Five-Year Review Guidance, Office of Emergency and Remedial Response (5204G), EPA 540-R-01-007, OSWER No. 9355.7-03B-P.

USEPA. 2004. Record of Decision. Cherokee County Superfund Site. Badger, Lawton and Waco Subsites. Operable Unit 6. Cherokee County, Kansas.

USEPA. 2006a. Record of Decision. Cherokee County Superfund Site. Baxter Springs and Treece Subsites. Operable Units 3 and 4. Cherokee County, Kansas.

USEPA. 2009. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Office of Superfund Remediation and Technology Innovation, Washington, D.C. OSWER Publication 9285.7-82.

USEPA. 2010. Explanation of Significant Differences. Tar Creek Superfund Site. Operable Unit 4. Ottawa County, Oklahoma and Cherokee County, Kansas.

USEPA. 2013. Integrated Science Assessment for Lead. EPA/600/R-10/075F. June.

USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120. Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA. 2015. Streamlined Ecological Risk Assessment. Cherokee County Railroads. Operable Unit 8. USEPA Region 7. Lenexa, KS.

USEPA. 2015. Fifth Five-Year Review Report for Cherokee County Superfund Site, Cherokee County, Kansas. September.

USEPA. 2016a. Record of Decision. Cherokee County Superfund Site. Operable Unit 8 – Rail Roads. Cherokee County, Kansas.

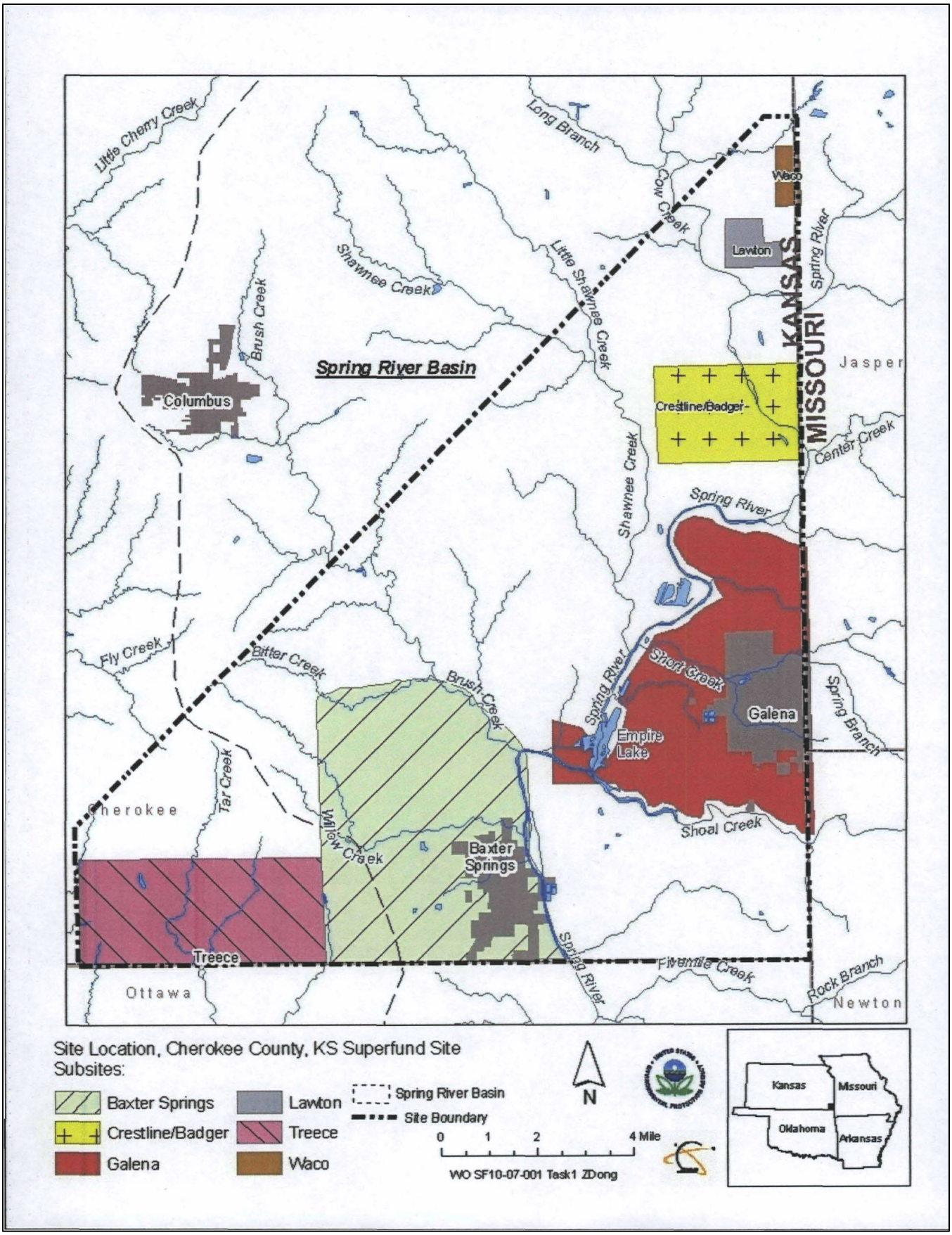
USEPA. 2016b. Record of Decision Amendment. Cherokee County Superfund Site. Operable Unit 4 – Treece subsite. Cherokee County, Kansas.

USEPA. 2018. Action Memorandum, Request for an Emergency Removal Action at the Cherokee County Superfund Site, Operable Unit 3 – Baxter Springs, Phase III Work Area #5. Cherokee County, Kansas.

USGS. 2005. Assessment of Contaminated Streambed Sediment in the Kansas Part of the historic Tri-State Lead and Zinc Mining District, Cherokee County, 2004.

APPENDIX B

SITE MAPS


Little Cherry Creek
Long Branch
Cow Creek
Waco
Lawton
Spring River
KANSAS
MISSOURI
Shawnee Creek
Little Shawnee Creek
Brush Creek
Spring River Basin
Columbus
Crestline/Badger
Jasper
Center Creek
Shawnee Creek
Spring River
Fly Creek
Bitter Creek
Brush Creek
Spring River
Short Creek
Galena
Spring Branch
Empire Lake
Cherokee
Tar Creek
Willow Creek
Baxter Springs
Shoal Creek
Treece
Spring River
Fivemile Creek
Rock Branch
Ottawa
Newton
Site Location, Cherokee County, KS Superfund Site
Subsites:
Baxter Springs
Crestline/Badger
Galena
Lawton
Treece
Waco
Spring River Basin
Site Boundary
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Kansas
Missouri
Oklahoma
Arkansas

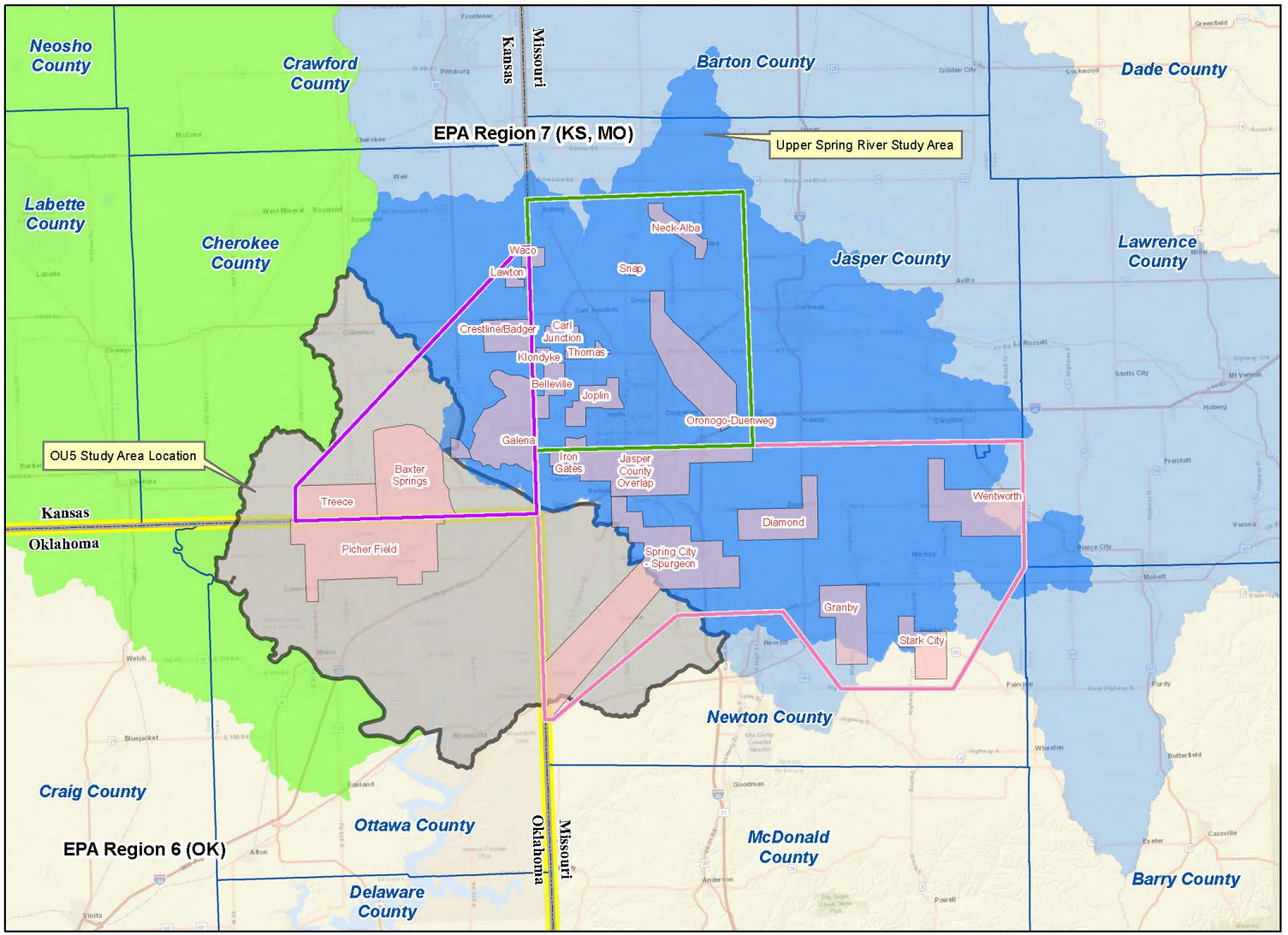

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Figure 2.1.
Tri-State Mining District Map
Tar Creek Superfund Site
Operable Unit 5 Remedial Investigation
Ottawa County, Oklahoma

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APPENDIX C

ENFORCEMENT INSTRUMENTS SUMMARY

APPENDIX C: Cherokee County Superfund Site, Sixth Five Year Review (September 2020)
Enforcement Instruments Summary

OPERABLE UNIT & SUB-SITE	SETTLEMENT – CONSENT DECREE OR ADMINISTRATIVE ORDER ON CONSENT	SETTLING PARTIES	SETTLEMENT INFORMATION	ACTIVE OPERATION & MAINTENANCE - SETTLING PARTIES
OU1 – Galena, Alternate Water Supply and OU5 – Galena Groundwater, Surface Water	*US v. Gold Fields, et. al*, Case No. 96-2416 (Dist. Kansas 1997)	Settling Defendants: Gold Fields and Viacom International, Inc.[2]	**Consent Decree, 1997** Reimbursement of Response Costs and payment of Future Costs	N/A
OU3 – Baxter Springs	In the Matter Of Cherokee County Site, Baxter Springs and Treece Subsites, U.S. EPA Docket No. VII-90-F-0010, May 8, 1990. (same AOC for Treece, different Respondents)	Respondents: Eagle-Picher Industries, Inc., ASARCO, Inc., AMAX, Inc., NL Industries, Inc. and Sun Company, Inc.	**Administrative Order on Consent, 1990** • Remedial Investigation • Human Health and Ecological Risk Assessment • Feasibility Study • RI/FS completed in June 1994	N/A
	US v. Asarco Incorporated, et al, Civil Action No: 99-1399 (Dist. Kansas, Jan. 12, 2000) (same as Treece, different Settling Defendants)	Settling Defendants for Baxter Springs OU3: ASARCO Incorporated; Cyprus Amax Minerals Company; NL Industries, Inc.; and Sun Company, Inc.	**Consent Decree, 2000** • Reimbursement of costs OU 3 • Remedial Design/Remedial Action OU3 • Operation and Maintenance	Cyprus Amax Minerals Company; NL Industries, Inc.; and Sun Company, Inc.

[2] Gold Fields Mining Corporation, its officers, and directors; and the following related entities and their officers, and directors: Tri-State Zinc, Inc., and Gold Fields American Corporation (collectively "Gold Fields"); and (2) Viacom International Inc., its officers, and directors; and the following related entities and their officers, and directors: New Jersey Zinc Company, Empire Zinc Company, Gulf & Western Industries, Inc., Gulf + Western Inc., and Paramount Communications Inc. (collectively "Viacom").

APPENDIX C: Cherokee County Superfund Site, Sixth Five Year Review (September 2020)
Enforcement Instruments Summary

OU4 – Treece	In the Matter Of Cherokee County Site, Baxter Springs and Treece Subsites, U.S. EPA Docket No. VII-90-F-0010, May 8, 1990	Respondents: Eagle-Picher Industries, Inc., ASARCO, Inc., Gold Fields American Corporation, and St. Joe Minerals Corporation	**Administrative Order on Consent, 1990** • Remedial Investigation • Human Health and Ecological Risk Assessment • Feasibility Study	N/A
OU4 - Treece	*US v. Asarco Incorporated, et al*, Civil Action No: 99-1399 (Dist. Kansas, Jan. 12, 2000) (same as Baxter Springs, different Settling Defendants)	Settling Defendants for Treece, OU4: ASARCO Incorporated (formerly Federal Lead Co. and Federal Mining and Smelting Company); Gold Fields Mining Corporation; Blue Tee Corporation; and The Doe Run Resources Corporation (formerly named St. Joe Minerals Corporation).	**Consent Decree, 2000** • Reimbursement of costs OU 4 • Remedial Design/Remedial Action • Operation and Maintenance	The Doe Run Resources Corp.
OU4 – Treece	*US v. Blue Tee Corp., et al,* Case No. 08-1316-MLB-KGG (Dist. Kansas 2013)	Settling Defendants: Blue Tee Corp., Gold Fields Mining, LLC, and The Doe Run Resources Corp.	**Consent Decree, 2013** • Remedial Design and Remedial Action • Operation and Maintenance	The Doe Run Resources Corp.
OU6 – Badger, Lawton, Waco, and Crestline	In the Matter of: Operable Unit 6, Badger, Crestline, Lawton and Waco Subsites, Cherokee County, Kansas, U.S. EPA Docket No. CERCLA-7-99-0002 (1998)	Respondents: Cyprus Amax Minerals Company; E.I. du Pont de Nemours and Company; NL Industries, Inc.; and Sun Company, Inc.	**Administrative Order on Consent, 1998** • Focused Remedial Investigation/ Presumptive Remedy Feasibility Study	N/A

APPENDIX C: Cherokee County Superfund Site, Sixth Five Year Review (September 2020)
Enforcement Instruments Summary

OU6 – Waco	*US v. E.I. du Pont de Nemours and NL Industries, Inc., Sunoco, Inc.,* CIVIL ACTION NO. 07-1304-MLB (Dist. Kansas 2007)	Settling Defendants: E.I. duPont de Nemours and Company; NL Industries, Inc.; and Sunoco, Inc.	**Consent Decree (Waco), 2007** • Remedial Design and Remedial Action Consent Decree • Operation and Maintenance • Residential Soils XRF Study	E.I. duPont de Nemours and Company; NL Industries, Inc.; and Sunoco, Inc.
OU6 – Crestline	*US v. Cyprus Amax Minerals Company*, CIVIL ACTION NO. 07-1109-MLB (Dist. Kansas 2007)	Settling Defendant: Cyprus Amax Minerals	**Consent Decree (Crestline), 2007** • Remedial Design and Remedial Action • Operation and Maintenance • Residential Soils XRF Study	Cyprus Amax Minerals Company
Site-Wide	In re: Eagle-Picher Industries, Inc. et al, Debtors, Consolidated Case No. 1-91-00100, Chapter 11 Bankruptcy (S. Dist. Ohio 1996)	Settling Defendant: Eagle-Picher, Inc	**Bankruptcy Settlement Agreement** • Reimbursement of Response Costs Past and Future	N/A
	In the Matter of Jasper County Site and Cherokee County Site, EPA Docket No. VII -94-F-0011 and EPA Docket No. VII -94-F-0012	Cyprus Amex Minerals Company, Blue Tee Corporation, Brown & Root, Inc., E.I. DuPont de Nemours and Company, Gold Fields Mining Corporation, ASARCO, Inc., NL Industries, Inc., and Sun Company, Inc.	**Administrative Order on Consent, 1994** • Remedial Investigation • Risk Assessment • Feasibility Study	N/A
	In re: Peabody Energy Corporation, Case No. 16-42529-399 (E. Dist. MO Bankruptcy, 2017)	Debtors: Peabody Energy Corporation ("PEC"), on behalf of itself and its 152 debtor affiliates including Gold Fields, Inc. and Gold Fields Liquidating Trust	**Bankruptcy Settlement, 2017** • Reimbursement of Response Costs Past and Future	N/A

	US, et al v. Blue Tee Corp, et al, Civil No. 3:18-cv-5097 (E. Dist. Missouri 2019)[3]	Settling Defendants: Blue Tee Corp., Brown Strauss Inc., David P. Alldian, Richard A. Secrist, and William M. Kelly.	**Consent Decree, 2019** • Reimbursement of Response Costs Past and Future	N/A

[3] US, Oklahoma, Missouri, Kansas, Illinois, Colorado, Montana, Tennessee, Eastern Shawnee Tribe of Oklahoma, Ottawa Tribe of Oklahoma, Peoria Tribe of Indians of Oklahoma, Seneca-Cayuga Nation, Wyandotte Nation, Miami Tribe of Oklahoma, and Cherokee Nation v. Blue Tee, et al.