PREASSESSMENT SCREEN
FOR THE
TAR CREEK SUPERFUND SITE

OTTAWA COUNTY, OKLAHOMA

PREPARED FOR THE

NATURAL RESOURCE TRUSTEES FOR
THE TAR CREEK SUPERFUND SITE

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Natural Resources Trustees for
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September 2004

EXECUTIVE SUMMARY

From the late 1800s - to the present, hazardous substances have been released into the environment from mining activities at the Tar Creek Superfund Site in Ottawa County, Oklahoma. The Tar Creek Site primarily covers approximately 40 square miles where underground mining was performed at hundreds of mines for nearly 75 years and extends to any other area where a hazardous substance from mining or milling in Ottawa County has been deposited, stored, disposed of, placed, or otherwise come to be located. Pursuant to the authority of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C §§ 9601 et seq. ("CERCLA"), and other applicable laws, the designated federal, tribal and state authorities are acting on behalf of the public or an Indian Tribe as natural resource Trustees to pursue claims for natural resource damages for injury to, destruction of, or loss of natural resources resulting from the release of hazardous substances to the environment from these mining activities. The first step in developing a potential natural resource damages (NRD) claim is the preparation of this Preassessment Screen.

The United States Environmental Protection Agency (EPA) added the Tar Creek mining district to the Superfund National Priorities List (NPL) in September 1983 because of elevated concentrations of metals at the Site. EPA, the State of Oklahoma and the affected tribes have performed a number of investigations of the releases of hazardous substances at the Site, and certain remedial activities intended to reduce or eliminate future exposure of human and ecological resources to the hazardous substances at the Site have been implemented. To date these activities have not been wholly successful in meeting that goal. Additional remedial and restoration activities are needed to fully address the releases of hazardous substances at the Tar Creek Superfund Site.

Facility Background

The Tar Creek Superfund Site was an active lead and zinc mining area from the late 1800s until the 1970s. Ore was recovered at over 200 small mines from underground workings and was milled both in the area and shipped to other locations for milling. These activities resulted in large surface deposits of mine wastes, primarily in chat piles and floatation pond residues containing residual minerals, over more than 40 sq. mi. of Ottawa County, Oklahoma. After the mines closed, groundwater filled the mine works, and eventually began discharging to surface waters in numerous locations. The water in the flooded mines

formed acid mine water from the dissolution of residual ore deposits, with low pH and high concentrations of several metals.

Discussion

Five criteria are specified in the Natural Resource Damage Assessment regulations (43 C.F.R § 11.23(e)(1-5)) to be used in a Preassessment Screen to determine whether there is a reasonable probability of making a successful claim for damages with respect to natural resources over which the Trustees have trusteeship. Readily available information was evaluated in this Preassessment Screen to determine whether these criteria were met. The five criteria are:

- Criterion 1. A release of a hazardous substance has occurred.
- Criterion 2. Natural resources for which the Trustees may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the release.
- Criterion 3. The quantity and concentration of the released hazardous substance is sufficient to potentially cause injury to natural resources.
- Criterion 4. Data sufficient to pursue an assessment are readily available or are likely to be obtained at a reasonable cost.
- Criterion 5. Response actions carried out or planned do not or will not sufficiently remedy the injury to natural resources without further action.

The Trustees have determined that all five of the above criteria have been met for the Tar Creek Superfund Site.

Releases

Investigations at the Site have documented the release of hazardous substances to the air, soil, surface water, and groundwater at the Tar Creek Site including, but not limited to, cadmium, lead, and zinc. These releases began in the late 1800s and still continue to this day.

Pathways and Exposed Resources

Pathways of concern include, but are not limited to, direct contact with contaminated mine wastes and impacted resources, as well as transport by groundwater, surface water, the food chain, and air. Documented exposed resources include land, fish, biota, air, surface water, groundwater, drinking water, plants, animals, and wildlife. Investigations from 1980 to the present have documented concentrations of several metals throughout the Tar Creek Site at concentrations much higher in the wastes, water, soils and groundwater than in comparable non-mined areas. Elevated concentrations of metals have also been documented in the surface waters and sediment of Tar Creek and tributary streams within the mined area as well as other streams and rivers downstream from the mined area. These contaminated media make up supporting habitat for, and provide potential exposure pathways to, biological resources. Concentrations of hazardous substances in the affected media have been sufficient to cause injury to terrestrial plants, fish and other aquatic resources, and potentially to other biological resources.

Response Actions

To date, the EPA has designated four Operable Units at the Site. Collectively, the Operable Units (OUs) address the release~~s~~ of acid mine water to certain surface waters and contaminated mine wastes and soils in residential and certain non-residential properties. Two of the OUs, Operable Unit 1 (OU1) and Operable Unit 2 (OU2), have subsequent Records of Decision (RODs). Operable Unit 1 attempted to reduce the discharge of acid mine water at the Mayer Ranch and Douthat Bridge sites by reducing or eliminating the recharge of the contaminated groundwater aquifer that is the source of the discharges at two specific locations, North of the border in Kansas and at the Douthat Bridge area only. OU1 had limited success in reducing the discharges from the mines and implementation of the borehole and shaft-plugging portion of the remedy is ongoing. Operable Unit 2 includes the removal of contaminated mine wastes and soils from residential and other high use properties. This action is ongoing, and other actions are planned, including the removal of mine wastes from non-residential properties. Operable Unit 3 (OU3) was an emergency removal action for various hazardous substances from the Eagle-Picher plant in Cardin, Oklahoma. The removal action was complete in 2000. Operable Unit 4 (OU4) will address certain contamination from former mining and mill residues, and smelter wastes deposited at the site by former mining-related operations.

Determination

Following the review of information described in this Preassessment Screen, the Trustees have made a preliminary determination that the criteria specified at 43 C.F.R § 11.23(e)(1-5) for Natural Resource Damage Assessments have been met. The Trustees have further determined that there is a reasonable probability of making a successful claim for damages with respect to natural resources over which the Trustees have trusteeship. Therefore, the Trustees have determined that an assessment of natural resource damages is warranted.

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LIST OF ABBREVIATIONS AND ACRONYMS

AOC	Administrative Order on Consent
Ba	Barium
BHHRA	Baseline Human Health Risk Assessment
BIA	Bureau of Indian Affairs
CCC	Criteria Continuous Concentration
Cd	Cadmium
THE CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMC	Criteria Maximum Concentration
CRIHB	California Rural Indian Health Board
CWA	Clean Water Act
DOI	United States Department of the Interior
EPA	United States Environmental Protection Agency
FIFRA	Federal Insecticide Rodenticide and Fungicide Act
ft	foot or feet
FWPCA	Federal Water Protection and Control Act
gpd	gallons per day
ITEC	Inter-Tribal Environment Council
MCL	Maximum contaminant level
Mg	Magnesium
NAAQS	National Ambient Air Quality Standard
NDIC	National Diabetes Information Clearinghouse
NEPA	National Environmental Policy Act
Ni	Nickel
NOAA	National Oceanic and Atmospheric Administration
NPDWR	National Primary Drinking Water Regulations
NPL	National Priorities List, Appendix B of the NCP
NRD	natural resource damages
NRDA	Natural Resource Damage Assessment
ODEQ	Oklahoma Department of Environmental Quality

OSDH	Oklahoma State Department of Health
OSE	Oklahoma Secretary of the Environment
OPA	Oil Pollution Act
OU	Operable Unit
OWRB	Oklahoma Water Resources Board
PAS	Preassessment Screen
PRG	preliminary remedial goal
PRP	Potentially Responsible Party
RBC	EPA Region III risk-based concentration
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of decision
SDWA	Safe Drinking Water Act
sq mi	square mile
TCSTF	Tar Creek Superfund Task Force
TCTFHES	Tar Creek Task Force Health Effects Subcommittee
TRV	toxicity reference value
UET	upper effects threshold
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
µg/l	Microgram per liter
Zn	Zinc

1.0 INTRODUCTION

1.1 Purpose

The Natural Resource Damage Assessment (NRDA) regulations instruct the Trustees to complete a Preassessment Screen ("PAS") prior to conducting formal injury assessment activities. (43 C.F.R.§ 11.23(a)). The purpose of this PAS is to provide a rapid review of readily available information on discharges or releases of hazardous substances and the potential resulting impacts on natural resources at the Tar Creek Site for which the Trustees may assert trusteeship under 42 U.S.C § 9607(f). The PAS review is intended to ensure that there is a reasonable probability of making a successful claim before monies and efforts are expended in carrying out an assessment, and to document the Trustees' determination that further assessment efforts are warranted. (43 CFR § 11.23(b)) This document fulfills that requirement for the Tar Creek Superfund Site and follows the structure of 43 C.F.R. Part 11 which allows, on behalf of the Trustees, the assessment of natural resource damages to have the force and effect of a rebuttable presumption in any administrative or judicial proceeding filed pursuant CERCLA or the FWPCA. (42 U.S.C. § 9607(2)(C)).

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, 42 U.S.C. §§ 9601 et seq., the Federal Water Pollution Control Act (FWPCA), as amended, 33 U.S.C. §§ 1251 et seq., and 40 C.F.R. § 300.600(2) states that the Secretary of the Interior shall act as trustee for natural resources managed or controlled by the DOI and those resources for which an Indian tribe would otherwise act as trustee in those cases where the United States acts on behalf of the Indian Tribe. CERCLA, FWPCA and 40 C.F.R. § 300.605 authorize State Trustees to act on behalf of the public as trustees for natural resources, including their supporting ecosystems, within the boundary of a state or belonging to, managed by, controlled by, or appertaining to such state. CERCLA, FWPCA and 40 C.F.R. § 300.610 authorizes Indian Tribes to serve as trustees for the natural resources, including their supporting ecosystems, belonging to, managed by, controlled by, or appertaining to such Indian tribe, or held in trust for the benefit of such Indian tribe, or belonging to a member of such Indian tribe, if such resources are subject to a trust restriction on alienation.

The Trustees are authorized to assess damages for injury to, destruction of or loss of natural resources. (42 U.S.C § 9607 (2)(a)-(b)). Claims may be pursued against parties that have been identified as potentially responsible for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury. (42 U.S.C. § 9607(a)(4)(c))

The sources of information relied upon for this PAS were collected to support remedial activities and for other purposes, and not with the intention of evaluating potential injuries to natural resources. As a result, some of this data may not be appropriate for determining and quantifying natural resource injuries. In the future, the Trustees may undertake further studies to establish appropriate baseline conditions, injuries, or for other NRDA-specific purposes.

This PAS has been prepared on behalf of the U.S. Department of the Interior (DOI), the State of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, the Seneca-Cayuga Tribe of Oklahoma, the Wyandotte Nation, the Peoria Tribe of Indians of Oklahoma, the Miami Tribe of Oklahoma and the Ottawa Tribe of Oklahoma (individually and collectively referred to in this PAS as "Trustees"). (This list is not comprehensive and other tribal governmental entities also may be natural resource Trustees but are not participating in this PAS).

1.2 Site Historical Background (43 C.F.R. § 11.24(a))

Lead and zinc mining first began at the Site in the late 1800s and reached its peak in 1925. In the early years, approximately 200 mills were operating at the Site (McKnight & Fisher 1970). The ore removed from the mines was milled locally to produce ore concentrates, which were generally shipped to other locations outside of Ottawa County for smelting. One smelter operated in the 1920's near Hockerville (McKnight & Fisher 1970). Large-scale mining activities ended in the mid-1960s (EPA 2000a).

The ore bearing strata were primarily located within a 50 to 150 foot-thick zone of the Boone Formation, approximately 90 to 400 feet (ft) below ground surface (USEPA 1994). Mining was accomplished using room and pillar techniques (USEPA 1994). An estimated 100,000 boreholes were located in the entire Picher Field (mostly in Oklahoma), and 1,064 mine shafts (typically 5 ft by 7 ft or 6 ft by 6 ft) existed in the Oklahoma portion of the mining district (USEPA 1994, Luza 1986). Numerous water wells, drilled for milling operations, have been abandoned (EPA 2000a).
As a result of decades of mining and milling, chat piles (mine tailings from the milling process, containing a mixture of gravel and finer-grained materials [EPA 2000a]), mill floatation ponds**,** tailing sites, development and waste rock piles, and subsidence ponds are prominent features of the landscape in Ottawa County. Much of this mill waste is contaminated with hazardous substances (Datin and Cates 2002).

In the early 1970's, when mining ceased permanently and pumping operations were terminated, the Boone Formation began refilling with water, flooding the mine drifts and shafts and creating acid mine water with high concentrations of metals (USEPA 1994). By 1979, water levels had increased to the point that the acid mine water began discharging at the surface from several locations (OWRB 1983a, USEPA 1994). Attempts to lower the groundwater level have not been successful, and acid mine water continues to discharge to surface waters in the Tar Creek watershed (EPA 2000a).

EPA included the Tar Creek Superfund Site on the Superfund National Priorities List on September 8, 1983 because of elevated concentrations of some metals in the mined areas of Ottawa County. The aerial extent of the Tar Creek Superfund Site includes the approximately 40 square miles (sq. mi.) where mining took place and mine wastes remain, as well as locations where releases of hazardous substances from the mining activities in Ottawa County, Oklahoma have been deposited, stored, disposed of, placed, or otherwise come to be located.

The EPA and the State of Oklahoma have since initiated a number of remedial investigations and identified four Operable Units (OUs) at the site. These OUs address certain surface water and groundwater releases (OU 1); the remediation of certain contaminated residential properties (OU 2); the removal of mining chemicals from the Eagle Picher plant (OU 3); and the remediation of chat piles and abandoned mill ponds in non-residential areas (OU 4). Records of Decision (RODs) were signed for OU 1 in June 1984 and for OU 2 in August 1997. Remediation has not been completed and remedial activities to date have not eliminated the release of hazardous substances to the surface water, groundwater, air, and soils at the Site.

2.0 RELEASE OF HAZARDOUS SUBSTANCES

This section summarizes readily available information reviewed by the Trustees related to the release of hazardous substances at the Tar Creek Superfund Site. It should be noted that the Trustees may identify or collect additional information to adequately define the nature and extent of contamination and injuries associated with the release of hazardous substances at the Site (43 C.F.R. § 11.24).

2.1 Timing, Quantity, Duration, and Frequency of Releases (43 C.F.R. § 11.24(a)(1))

Mining and the associated releases of hazardous substances from mine wastes, including chat and mill pond sediments, began in the late 1890s and peaked in the mid- to late 1920s. (McKnight 1970) The mining operations continued until the 1970s but residual mine wastes are still present throughout the mined area. Currently, an estimated 50 million cubic yards or 75 million tons of chat remain in Ottawa County (TCSTF 2000c), covering over roughly 5,000 acres (EPA 2000a; Luza 1986; Ottawa County Soil Survey 1964). Releases from the mine wastes began with the placement of mine tailings in ponds and chat on the ground, and hazardous substances continue to be released from these sources to land, air, surface water and groundwater on a daily basis. By 1943, the Central Mill had treated 21,290,472 tons of ore and produced 1,163,612 tons of zinc concentrates and 164,984 tons of lead concentrates (Isern, 1943). The material that was not ore was placed on the ground surface as chat.

In addition, hazardous substances were released by the pumping of the mine caverns during active mining. (McCuskey 1935) Studies summarized below have shown that once the mining ended, and the pumps used to keep the mines dry were turned off, the mines and shafts filled with water, forming acidic conditions from oxidized minerals found in the remaining ore and rock in the mines and shafts, and resulted in the discharge of mine water with high concentrations of the metals. Releases of contaminated mine water through seeps to land and surface waters have been observed from 1979 and continue on a daily basis to the present (USEPA 2000). The contamination may extend at least as far as Grand Lake (Aggus 1982). The extent of groundwater contamination within the Boone aquifer is considered to reach over an area of at least 47 sq mi below the mined areas, but may be substantially larger (Houts 2002).

2.2Hazardous Substances Released (43 C.F.R §11.24(a)(2))

Hazardous substances that have been documented at the Tar Creek Site include, but are not limited to, cadmium, lead, and zinc (Playton et al. 1980; Parkhurst et al. 1988; Datin and Cates 2002). These substances have been identified under 42 U.S.C § 9601(14) and 40 C.F.R. § 302.4 as hazardous.

2.3 History, Current/Past Use, and Relevant Operations Identified as Sources of Releases (43 C.F.R. § 11.24(a)(3)(4))

In the late 1800s, the land within the boundaries of the Tar Creek Superfund Site became an active lead and zinc mining, milling and smelting area. The history of the mining operations at the Tar Creek Superfund site is outlined in Section 1.2 above. Prior to the initiation of mining in the area, the cattle drovers heading to market in both Kansas City and St. Louis used the area as pasture. In addition, hay was routinely exported from the Site by rail, and at the turn of the century, the Picher area was the nation's leading exporter of native hay (Texas Longhorn History 2000). Tribal cultural practices in the area, including, hunting, gathering, use of certain areas for ceremonies and dances, and gathering

resources for medicines, crafts and ceremonial uses, are long-established and existed before the mining began (Seneca-Cayuga Tribe 1999a ; Seneca-Cayuga Tribe 1999b).

Because mining, milling and smelting wastes and associated contamination cover more than 40 square miles of the surface in Ottawa County, thousands of acres of land are no longer used for farming, cattle grazing, hunting, fishing, gathering, and historic tribal practices. The land directly impacted and covered by mining waste supports limited if any vegetation. (USEPA, 2003)The groundwater in the Boone Formation underlying the Site is no longer suitable for human consumption in many areas (DEQ 2004) and it is likely that surface waters in the area only support in-stream communities of only tolerant organisms and/or species that are able to seek refuge within the stream or relocate.

The practice of stockpiling contaminated mine wastes near the mine workings throughout the Tar Creek Site has created areas of direct exposure to mine wastes and contamination of soils, as well as transport of the wastes through erosion and dissolution in rainwater and runoff. In addition, chat has been used in construction activities and thereby been transported away from the mines (EPA 1997).

Surface and groundwater have accumulated in the abandoned mines. The water has dissolved metals from the remaining mineral deposits, contaminating the Boone aquifer throughout the mined area (Christenson 1995). In addition, the surface openings of many mine shafts and thousands of boreholes are lower than the groundwater elevations, resulting in the discharge of mine water with high concentrations of dissolved metals to local streams and Tar Creek (EPA 1984, EPA 2000a).

Relevant operations include: exploratory boreholes that currently serve as release points for mine seeps, pumping of water from the mines that may have contained high levels of metals, blasting and opening of the ore bodies (creating additional voids and fractures through which contaminated mine water migrates), removal of the ore and milling or crushing operations that created vast piles of waste rock containing heavy metals, re-milling or flotation separation processes that created fine tailing in tailings impoundments. Additional activities included breaching the dykes of the tailings ponds to avoid over-capacity, washing the tailings to produce size-separated tailings for sale, loading and hauling the ore and the waste rock, placement of tailings on the earth both on dry land and near creek beds, use of chat materials for making driveways, roads and to fill in playgrounds (E&E 1996a). There may have been other operations at the site related to the mining that are not recounted in the PAS.

2.4 Additional Hazardous Substances Potentially Discharged or Released from the Site (43 C.F.R. § 11.24(a)(5))

The substances identified to date as primary concerns to the Trustees, as the likely cause of injuries to natural resources in the areas of release at the Site, are the metals associated with the mine wastes and acid mine water. However, the Trustees recognize that new studies may identify additional substances and these may be included in the damage assessment. Examples of such substances include asbestos from on-site buildings, chemical agents from past milling operations and floatation processes, and hydrocarbons from fuels, lubricants, and other operational uses. Other metals identified from preliminary sampling that may be present include: aluminum, copper, manganese, magnesium, and nickel.

2.5 Potentially Responsible Parties (43 C.F.R § 11.24(a)(6))

Through a review of the EPA administrative record, including 104(e) Notice Letters, other administrative action notices, and information requests between 1983 and 2000, the Trustees have identified the following individuals, corporations, government agencies, and other entities as potentially responsible parties (PRPs):

- Asarco, Inc.
- Azcon Corporation
- Barney Waters
- Blue Tee Corporation
- Childress Royalty Company
- Eagle Picher Industries
- Estate of Dewey S. Sims
- Garold Brown
- Gold Fields Mining Corporation
- Henry Eby
- LTV Jones & Laughlin Steel Corporation
- NL Industries
- O.K. Tucker
- Orville Moore
- Robert J. Conrad, Sr.
- Sam Dyer
- The Beck Company
- The Doe Run Resources Corporation
- The St. Joe Minerals Company
- Tim Kiser
- United Development Corporation
- U.S. Department of the Interior
- W.A. Brewer
- Youngstown Steel and Tube Company

The Trustees may identify other PRPs in the future.

2.6 DAMAGES EXCLUDED FROM LIABILITY (43 C.F.R § 11.24(B)-(C))

The NRDA regulations require that the Trustees evaluate whether the natural resource damages being considered are excluded from liability under the CERCLA or the Clean Water Act (CWA) (43 CFR § 11.24). If such damages are excluded from liability under CERCLA or the CWA, then an assessment of associated potential injuries is not to be continued under these regulations.
Damages resulting from the discharge or release of the hazardous substances at the Tar Creek Superfund Site were not identified in any environmental impact statement, pursuant to the National Environmental Policy Act (NEPA), as amended (42 U.S.C. §§4321 et seq.), or any similar review or document. (43 C.F.R. § 11.24(b)(1)(i)).

The releases of the hazardous substances at the Tar Creek Superfund Site are ongoing and did not occur wholly before enactment of the CERCLA. Injuries to natural resources and resultant damages to the public from the release or discharge of the hazardous substances are ongoing and did not occur wholly before enactment of CERCLA, (43 C.F.R. § 11.24(b)(1)(ii)).

The hazardous substances at the Tar Creek Superfund Site are not pesticide products registered under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) (7 U.S.C. § 135-135k). Damages resulting from the discharge or release of the hazardous substances at the Tar Creek Superfund Site did not result from the application of a FIFRA-registered pesticide product. (43 C.F.R. § 11.24(b)(1)(iii)).

Damages resulting from the discharge or release of the hazardous substances at the Tar Creek Superfund Site did not result from any federally permitted release as defined in 42 U.S.C. § 9601(10). (43 C.F.R. § 11.24(b)(1)(iv)).

The hazardous substances are not recycled oil products as described in 42 U.S.C. § 9607(a)(3) or (4). Damages resulting from the discharge or release of the hazardous substances at the Tar Creek Superfund Site did not result from release of a recycled oil product. (43. C.F.R. § 11.24(b)(1)(v)).

The Trustees do not believe that any of these exclusions eliminate liability for natural resource damages resulting from releases of hazardous substances from the Tar Creek Site, and therefore the continuation of an assessment is not precluded .43 C.F.R. 11.24(2).
The discharges released from the Tar Creek Site do not fall under one or more of the exclusions provided in the FWPCA, 33 U.S.C. § 1321(a)(2) or (b)(3), and therefore the continuation of an assessment is not precluded. (43 C.F.R § 11.24(c)(1)-(2)).

3.0 PRELIMINARY IDENTIFICATION OF RESOURCES POTENTIALLY AT RISK

The following sections summarize the readily available information regarding potential exposure pathways, exposure concentrations and potentially exposed resources under the trusteeship of the Trustees. Since the ecosystem functions as a system, the resources are interconnected and injury to one resource may impact additional resources negatively as well. Additional resources and pathways for exposure may be identified and added as the Assessment Phase proceeds. (43 C.F.R. § 11.25).

3.1 Preliminary Identification of Pathways

The following sections summarize the readily available information regarding the transport of hazardous substances released from the Tar Creek mining areas through various pathways to natural resources over which the Trustees may assert trusteeship. Exposure pathways are defined as the routes or media through which a hazardous substance is or was transported from the source of a discharge or release to the injured resource (43 C.F.R.§ 11.14(dd)). Factors to be considered in this determination should include as appropriate, the circumstances of the discharge or release, the characteristics of the terrain or body of water involved, weather conditions, and the known physical, chemical, and toxicological properties of the oil or hazardous substance. (43 C.F.R. § 11.25). Pathways to be considered shall include, as appropriate, direct contact, surface water, ground water, air, food chains, and particulate movement. (43 C.F.R. § 11.25(3)).

For a period of over 100 years, hazardous substances produced during the extraction, transportation, and processing of ore at the Tar Creek Site were released from mines, mills, and chat piles (waste dumps and stockpiles) or mill ponds (unlined settling ponds) (McKnight & Fisher 1970). Hazardous substances attributable to these sources, including, but not limited to lead, cadmium and zinc, (Datin and Cates 2002) continue to be present in and migrate through groundwater, surface waters, soils, and air of Ottawa County, the Tar Creek Watershed and potentially through biological pathways (Adams 1980, OWRB 1983a, OSSH 1983). (It should be noted that contamination has spread beyond to other watersheds as well.)

3.1.1Soil Exposure Pathways (43 C.F.R § 11.25(3))

Soil exposure pathways can comprise, but are not limited to, mine wastes-to-soil pathways. The chat piles and the residual floatation pond sediments contaminate soils. In addition, wind and water erosion, as well as the use of the chat and mill pond residues as fill and as construction material (TCSTF 2000c), have resulted in contaminated soils in many other locations.

When mine wastes are disturbed by human activities contaminated dust may be formed (E&E 1996a, Dames and More 1993). The residual minerals in the chat and millpond residues result in the releases of hazardous substances to soils (OWRB 1983b).

Hazardous substances in these mine wastes may be transferred to soils by direct contact and may also be transported to surface water resources (including sediments) through physical processes, including erosion and mass wasting. It is suspected that there is a pathway from groundwater and surface water to soils. Soils make up an important component of terrestrial habitat, and biological resources, including wildlife, plants, and soil invertebrates, may be exposed to hazardous substances in soils by a number of pathways, including uptake by inhalation, ingestion, and dermal contact.

3.1.2 Groundwater Pathways (43 C.F.R § 11.25(3**))**

Hazardous substances have contaminated the Boone Aquifer throughout the mined area (OWRB 1983d, OWRB 1983e). As the Boone Formation began refilling with water, the water flooded the mine workings and created acid mine water with high concentrations of metals, including but not limited to, cadmium, lead and zinc (USEPA 1994). Groundwater of the Boone Aquifer has been and continues to be contaminated by hazardous substances at the Site as it flows through the underground mine workings

(DeHay 2003). Numerous mineshafts and boreholes occur in the mining district. These provide access points that allow contaminated groundwater to flow into surface waters of streams, and also allow contaminated surface runoff to enter groundwater (Dames and Moore 1993). Furthermore, rainwater percolating through piles of mine waste leaches hazardous substances into the shallow groundwater.

Abandoned deep wells and natural geologic features can act as transport mechanisms by which the contamination in the Boone Aquifer may migrate into the Roubidoux Aquifer (Oklahoma Department of Environmental Quality [ODEQ] 2002). Monitoring indicates that the Roubidoux aquifer has been locally impacted by mine water (ODEQ 2002).

3.1.3 Surface Water Pathways (43 C.F.R § 11.25(3))

Surface waters include lakes, rivers, ponds, streams, and wetlands. According to the NRDA regulations, surface waters also include sediments suspended in water or lying on the bank, bed, or shoreline (43 CFR § 11.14{pp}).

The surface waters at the Site receive hazardous substances directly through erosion of the mine waste from the chat piles, pond residues, and contaminated soils, and potentially from the deposition of airborne dust. In some cases, surface water flows through stream channels composed entirely of metals laden chat. The percolation of rainwater through chat piles dissolves the hazardous substances forming leachate, resulting in contaminated seeps to surface water (TCSTF 2000) In addition, numerous springs and seeps from mine openings transport groundwater that carries dissolved metals and other substances to the surface where they flow into streams and ponds (OWRB 1983, OWRB 1983a, USEPA 1994, TCSTF 2002a).

Erosion of contaminated chat, pond sediments, and soils; direct releases of mine wastes to surface streams; and precipitation of dissolved metals have resulted in the contamination of the sediments throughout the Tar Creek watershed within and downstream of the mined areas (OWRB 1983, OWRB 1983a USEPA 1994, TCSTF 2002a). A full transport model has not been conducted, however it is possible that the water and sediments within Tar Creek and other surface streams have carried hazardous substances released in the mined areas downstream at least as far as Grand Lake, near the discharge of the Neosho River (Aggus et al 1982). There are indications that contaminated sediments are present in the Spring River. (Hope 2000) (DEQ 2003).

It is suspected that heavy metal concentrations in fish tissues are higher in areas where the largest quantities of heavy metals are found (DEQ 2003). In addition, detritivores and planktivores contain higher concentrations of lead and zinc than predator fish (Aggus et al 1982).

3.1.4 Air Pathway (43 C.F.R § 11.25(3))

During the active mining period, at least one smelter, located east of Picher near Hockerville, processed lead and other metals for more than 10 years during the 1920's (McKnight & Fisher 1970, EPA 1997). Exhaust from smelters released volatilized metals and fine particles of metals in dust directly into the air; the particles were transported by air and were deposited later over land and surface water.

Additionally, wind continues to disperse fugitive dust containing metals as it flows over chat piles and across dry tailing ponds (E&E 1996).

3.1.5 Food Chain-Pathways (43 C.F.R § 11.25(3))

Contaminants have the ability to move through the food chain by dermal contact and ingestion of soil, sediment, surface water, and prey. Potential pathways include accumulation from the abiotic media and transfer through the food chain as contaminated organisms are consumed.
Terrestrial and wetland plants take up hazardous substances dissolved in soil moisture and incorporate these into root, stem and leaf tissues (Dames and Moore, 1993a).

Limited data are currently available regarding the contamination of biological resources in most of the potentially affected areas of the Site. Surface water and sediments make up an important component of the food chain pathways. Fish samples collected from the Neosho River below the Tar Creek confluence contained some elevated levels of lead and zinc (USFWS 1981). In addition, recent studies by USFWS indicate that migratory waterfowl found in the area may be impacted by exposure to heavy metals in the environment (Beyer 2004).

3.2 Estimates of Exposed Areas and Concentrations

Estimates of exposure concentrations in natural resources discussed in the following sections are generally limited to soils, groundwater, surface water, sediment, and, to a lesser degree, resident fish species, because of the lack of readily available information related to exposure concentrations in other resources. (43 C.F.R. § 11.25(b)). Contaminated sediments may reach much further than the areas where visible mine wastes remain. These would be areas of indirect effect (43 C.F.R § 11.25(3)).

From the late 1800s - to the present, hazardous substances have been released into the environment from mining activities at the Tar Creek Superfund Site in Ottawa County, Oklahoma. The Tar Creek Site primarily covers approximately 40 square miles where underground mining was performed at hundreds of mines for nearly 75 years and extends to any other area where a hazardous substance from mining or milling in Ottawa County has been deposited, stored, disposed of, placed, or otherwise come to be located. Pursuant to the authority of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C §§ 9601 et seq. ("CERCLA"), and other applicable laws, the designated federal, tribal, and state authorities are acting on behalf of the public or an Indian Tribe as natural resource Trustees to pursue claims for natural resource damages for injury to, destruction of, or loss of natural resources resulting from the release of hazardous substances to the environment from these mining activities.

Where data are available, maximum concentrations observed during historical investigations, usually from the early 1980s, and maximum concentrations observed during recent studies are presented to demonstrate that elevated concentrations of hazardous substances have existed in areas affected by the mining-related releases from the earliest studies and continue to the present. The data presented do not reflect a complete or comprehensive compilation of all of the information available; however, all relevant data have been reviewed during the compilation of this Preliminary Assessment Screen. Similarly, the substances included in the following summary tables are not the only hazardous substances or constituents that the Trustees may determine have injured or are injuring natural resources, but were selected to demonstrate the potential degree and extent of the impacts to the natural resources at the Site. Only data sufficient to demonstrate the likelihood that a damage assessment would establish injury to one or more of the natural resources at the Site are presented.

3.2.1 Exposed Soil Resources Estimates and Concentrations (43 C.F.R § 11.25(b)(2) and (3)(d))

The Ottawa County Soil Survey reports 5,268 acres in Ottawa County covered by chat piles, millponds and other mine wastes (Ottawa County Soil Survey 1964). It is estimated that there are about 75 million tons of mine wastes in these areas (EPA 2000a; Luza 1986). The EPA has detected mining-related metals contaminating the soils at over 2,000 residential and other properties with high human uses (EPA 2000a). Additionally many acres of soils may have been contaminated by chat spread through anthropogenic and natural transport. Sediments near streams have been mixed with chat and fine tailings from runoff from chat piles and contain high levels of metals in many cases (EPA 2004).

Table 1 presents data selected to illustrate the concentrations of metals observed in the soils and mine wastes at the Site. The location used for comparison is the reference area identified by the EPA in the Baseline Human Health Risk Assessment (BHHRA), the town of Afton in southern Ottawa County (Ecology & Environment, 1996). Average soil background concentrations for Ottawa County are included in the table (Cates 2003). The table also includes, for comparison, the toxicity reference values (TRVs) and preliminary remedial goals (PRGs) for plants, soil invertebrates, and small mammals that were obtained from other studies and indicate the concentrations at which injuries to the biota may occur.

The concentrations of metals in the majority of chat pile samples taken by the ODEQ and the Bureau of Indian Affairs (BIA) greatly exceed the 500 mg/kg human health action limit (E&E 1996b) for Pb established by the EPA (EPA 1997). In addition, 73 percent of the 2,055 properties that EPA sampled as part of OU 2 showed lead concentrations greater than 400 mg/kg (Moore 1996). The average Pb, Cd and Zn concentrations for soils sampled at 100 properties in Picher are 852 mg/kg, 34 mg/kg and 5,758 mg/kg, respectively (E&E 1996).

The estimate of at least 5,000 acres of chat deposition on soils noted above does not include the spatial extent of contamination spread by the transport pathways described above or by the use of chat in construction materials. The known contaminated areas in the cities of Picher, Cardin, Commerce, North Miami, Quapaw, and most recently Miami, are only an indication of such transport in Northeastern, OK.

Table 1.Summary of selected chemical concentrations in soil and mine waste samples from the Tar Creek area.

Location	Parameter (mg/kg)	Maximum Concentration in Mined Areas	Maximum Concentration from Non-mined Location/ Mean soil Concentrations for Ottawa County	Plants TRV[6]	Earthworms TRV[6]	Short-Tailed Shrew PRG[6]
Residential areas in Picher, Cardin, Commerce, Quapaw, and North Miami, OK	Cadmium	**259[1]**	12[1,2]/ 0.46[9]	4	20	6
	Lead	**16,560[1]**	348[1,2]/ 16.7[9]	50	500	740
	Zinc	**38,258[1]**	2,830[1,2]/ 47[9]	50	200	1,600
Millpond south of Picher	Cadmium	50[3]	12[1,2]	4	20	6
	Lead	3,429[3]	348[1,2]	50	500	740
	Zinc	11,260[3]	2,830[1,2]	50	200	1,600
Kenoyer North Chat Pile	Cadmium	71[4]	12[1,2]	4	20	6
	Lead	2,207[4]	348[1,2]	50	500	740
	Zinc	**34,407[4]**	2,830[1,2]	50	200	1,600
Kenoyer South Chat Pile	Cadmium	96[4]	12[1,2]	4	20	6
	Lead	563[4]	348[1,2]	50	500	740
	Zinc	23,247[4]	2,830[1,2]	50	200	1,600

[1] Pre-remediation concentrations as reported in Ecology & Environment (1996). [2] EPA reference area in Afton, Ottawa County, OK. [3] Concentrations as reported in Brown and Root Environmental (1997). [4] Concentrations as reported in Datin and Cates (2002). [5] Concentrations as reported in OWRB (1983). [6] Efroymson et al., 1997b. [7] Efroymson et al., 1997a. [8] Efroymson et al., 1996. [9] Concentrations reported in Cates (2003)

Bold values indicate concentrations at least 10 times the maximum concentration from comparison samples (non-mined areas).

mg/kg = milligrams per kilogram TRV = Toxicity reference value PRG = Preliminary remedial goal

3.2.1 Exposed Groundwater Resources Estimates and Concentrations (43 C.F.R § 11.25(b)(2) and (3)(c)and(d))

Contamination within the Boone aquifer has been estimated to extend approximately 50 sq mi (Houts 2003); however, the water in the aquifer flows to the west (Osborn 2001) and the actual plume of contamination may be substantially larger. Samples taken outside the mining area exhibited elevated concentrations of select metals (Playton 1989, OWRB 1983d, DeHay 2003, Osborn 2002). Examples of the concentrations that have been observed in historic and recent studies for selected metals and other constituents are presented in Table 2.

Less information is available regarding the extent of contamination in the deeper Roubidoux aquifer. Contamination by mine-related substances has been observed in some, but not all, wells tested to date from the Roubidoux aquifer (Christenson 1995). The confining layers between the two aquifers may not be continuous or a complete aquitard in some areas (Playton et al 1980), allowing downward migration of contaminated groundwater from the Boone aquifer (Christenson 1994). In addition, some poorly constructed or maintained wells have been shown to provide a conduit for the same downward transport (USEPA 1994, TCSTF 2002a).

An estimate of exposed groundwater is derived from the estimates made by Spruell using a porosity of 7%, thickness of 200 feet in the Boone, a 14 foot thick zone of water exists. Using a 47 square mile estimate of underground mine workings or test holes from the Luza report, indicates the extent of potential groundwater contamination. Forty-seven square miles times 640 acres/sq. mi. equals 30,080 acres times 14 feet of groundwater or approximately 421,120 acre feet of possibly contaminated groundwater. In addition, DEQ's after action monitoring report for OU 1 indicated potential contamination of the Roubidoux in localized areas (Houts, 2002) (DEQ 2002).

Table 2. Summary of selected chemical concentrations in groundwater samples from the Tar Creek area.

Parameter	Location	Maximum Concentration	Comparison Criteria
2002 Mine Shaft Water Sampling[1]			
Cadmium (ug/L)	Consolidated #2	**111**	5[2]
Lead (ug/L)	Baby Jim	**32.7**	15[3]
Zinc (ug/L)	Admiralty #4	**11,100**	5,000[4]
Iron (ug/L)	Admiralty #4	**56,300**	300[4]
pH[5]	Admiralty #3	**5.6**	6.5[4]
1983 Borehole Water Sampling[6]			
Cadmium (ug/L)	Sec 16, T 29N, R 23E	**133**	5[2]
Lead (ug/L)	Sec 16, T 29N, R 23E	**124**	15[3]
Zinc (ug/L)	Sec 16, T 29N, R 23E	**252,000**	5,000[4]
Iron (ug/L)	Sec 16, T 29N, R 23E	**300,000**	300[4]
1980-82 Mine Shaft Water Sampling[6]			
Cadmium (ug/L)	Lawyer	**255**	5[2]
Lead (ug/L)	Consolidated #2	**121.3**	15[3]
Zinc (ug/L)	Admiralty #4	**331,000**	5,000[4]
Iron (ug/L)	Lawyer	**345,000**	300[4]
pH[5]	Lawyer	**4.55**	6.5[4]
1976-77 Mine Shaft Water Sampling[1]			
Cadmium (ug/L)	Skelton	**1,200**	5[2]
Lead (ug/L)	New Chicago	**500**	15[3]
Zinc (ug/L)	Lucky Bill, Birthday	**490,000**	5,000[4]
Iron (ug/L)	Lucky Bill	**330,000**	300[4]
pH[5]	Skelton, Birthday	**3.4**	6.5[4]

[1] Concentrations as reported by DeHay (2003). *Values reported are dissolved concentrations.

[2] SDWA MCL (EPA, 2002b).

[3] SDWA Action Level requiring treatment technology (EPA, 2002b).

[4] Secondary Drinking Water Standard (EPA, 2002b).

[5] Minimum values used for this parameter, rather than maximum.

[6] Concentrations reported by OWRB, 1983d (as cited in TCSTF, 2000a). **Values reported are total concentrations.

Bold values indicate concentrations at least 10 times the comparison criteria.

MCL = maximum contaminant level ug/L = micrograms per liter

3.2.3 Exposed Surface Water and Sediment Resources Estimates and Concentrations (43 C.F.R § 11.25(b)(2) and (3)(c)and(d))

Surface waters, including sediments, of the Tar Creek watershed have been exposed to hazardous substances released from mining wastes and transported through runoff and overland flow, discharges of contaminated mine water, and through the discharge of contaminated groundwater (Adams 1980, OWRB 1983a, OWRB 1983b and Parkhurst et al 1988).

The rivers and streams of the Neosho River watershed drain a portion of the mining area. The Neosho River flows from the Kansas state line southeasterly approximately 25 miles into Grand Lake. It flows to the west and south of the mining area. The Neosho River watershed in Oklahoma includes Squaw Creek, Four Mile Creek, Elm Creek, Tar Creek, Little Elm Creek and Spring River. The Tar Creek watershed in Oklahoma includes Lytle Creek, Garrett Creek, several unnamed creeks on the east side, and one unnamed creek on the west side that flows through North Miami and joins Tar Creek in Miami (USGS Quarter Quad maps: Miami NW, Miami, SW, Miami SE, Welch North, Welch South, Picher, Peoria, Wyandotte, Afton and Afton NE).

The Spring River and its tributaries also drain portions of the mining area. The Spring River flows into Oklahoma from Kansas line just south of Baxter Springs and at its confluence with the Neosho River forms Grand Lake of the Cherokees. The main tributaries to Spring River in Oklahoma are Beaver Creek on the west side near Quapaw, and on the east side Lost Creek, Shawnee Branch, Flint Branch, Warren Branch, Devil's Hollow, and Five Mile Creek.

The extent of the surface waters contaminated by releases from the mining activities has not been fully ascertained to date. For example, the headwaters of Elm Creek located west of Tar Creek originate in the midst of waste chat piles. Elm Creek flows along side many other chat piles as it meanders to the confluence with the Neosho River but has yet to be sampled for contaminant levels. Tar Creek and Lytle Creek are highly impacted by Pb, Cd and Zn (Adams 1980, OWRB 1983a, Parkhurst 1987). Metals associated with the mining releases have been found at elevated concentrations in the sediments of Grand Lake, establishing contamination has been transported downstream (Adams 1980, OWRB 1983a, McCormick and Burks 1987). Data collected from storm water runoff from a seven acre tailings pile in Missouri demonstrated that Pb concentrations in the runoff generated during a storm event averaged 228 ppm - a level 50 times greater than regional background concentrations in surface water (Barks 1977).

The Spring and Neosho Rivers exhibit elevated levels of metals in sediments. Ponds and millponds at the site have seen limited sampling but evidence signs of metals in sediments as well (ODEQ 2003). Using digital ortho photographs of the area available from the Oklahoma Conservation Commission and Stream Files from the Oklahoma Atlas published by the Oklahoma Geographic Information System Council, DEQ estimates over 84 stream miles in Ottawa County have been exposed to mining related contamination (DEQ 2004). Using available United States Geological Survey (USGS) stream flow data for Tar Creek, Spring River and the Neosho River, a conservative estimate of the mean daily volume in the area streams exposed to metals contamination created by the mining activity that ultimately reaches Grand Lake is 3,521 million gallons per day (gpd) (Houts 2002).

3.2.3.1 Surface Water Concentrations (43 C.F.R § 11.25(b)(2) and (3)(c)and(d))

Selected data demonstrating the concentrations of the metals released at the site in the surface waters are presented in Table 3. In the absence of a background study, the sites used for comparison are those located on the Neosho River (Sites 22a and 22b) and the Spring River (Sites 23 and 24) in the 1983 Oklahoma Water Resource Board (OWRB) study. The Maximum Contaminant Levels are the National Primary Drinking Water Regulations (NPDWRs or primary standards) applying to drinking water systems (EPA, 2002b). The Criteria Continuous Concentration (CCC) and Criteria Maximum Concentration (CMC) for the protection of aquatic life are the national recommended water quality criteria for chronic and acute exposure, respectively, to toxic pollutants (EPA 2002d).

Recent data from Beneficial Use Monitoring Program (BUMP) taken at the Spring River near Quapaw indicate that 23% of the Pb concentrations exceed the 5.32 μg/l chronic criteria. In addition, 43% of the Zn concentrations exceed the chronic criteria of 149.23 μg/l and 33% of the Zn samples exceed the acute criteria of 164.74 μg/l (OWRB 2003). Tar Creek, Spring River and segments of Grand Lake are currently on the state's 303 (d) list of impaired streams due, in part, to metals contamination. Although the Neosho River is not currently on the list, a recent fish tissue study conduct by ODEQ indicates that lead (possibly other metals) is found at high levels in some samples of all fish species in the Neosho River, indicating that metals contamination in the Neosho River is impacting aquatic life.

Table 3 shows maximum measured concentrations from several surface water sampling efforts over time at the Tar Creek Site. The United States Geological Survey (USGS), in cooperation with the area tribes and the Oklahoma Department of Environmental Quality are currently conducting base-flow and high – flow surface water sampling at selected locations in the area. Comparison criteria for some metals are dependant on the hardness of the water (amount of other minerals present). For lead, EPA has not established a Maximum Contaminant Level. For comparison purposes the tap water recommended level is used.

Table 3. Summary of selected chemical concentrations in surface water of the Tar Creek area [Table revised to include data from different areas and comparison concentrations]

Parameter	Unit	Maximum Concentrations[1]								Comparison Criteria			Concentration Range for Comparison Samples[2]
		Tar Creek Stations					Mine Discharges						
		Site 7, at N boundary of Ottawa Co.	Site 4, near confluence with Lytle Creek	Site 10, above Commerce	Site 14b, below Commerce	Site 20, above confluence with Neosho River	Site 4S near confluence of Tar Ck and Lytle Ck	Site 13, near Commerce	Site 4t (Tailings pile)	MCL	CMC	CCC	
Cadmium	**ug/L**	**23**	**260**	**82**	**69**	**63**	**310**	**430**	**270**	**5**	**3.9[3]**	**0.4[3]**	**<2 – 3**
Lead	**ug/L**	**287**	**1,920**	**1,090**	**47**	**196**	**141**	**282**	**40**	**15[4]**	**1.36[3]**	**5.3[3]**	**<20 – 27**
Zinc	**ug/L**	**13,800**	**141,000**	**151,000**	**137,000**	**104,000**	**342,000**	**130,000**	**34,900**	**5,000[5]**	**211[3]**	**213[3]**	**161 – 1,190**
Iron	**ug/L**	**52,000**	**290,000**	**162,000**	**129,000**	**52,000**	**480,000**	**133,000**	**180**	**300[5]**	**n/a**	**1,000**	**1,430 – 2,860**
Specific Conductance	**uS/cm**	**1,676**	**3,880**	**3,140**	**3,380**	**3,140**	**5,500**	**4,530**	**2,650**	**n/a**	**n/a**	**n/a**	**311 – 565**
pH[6]	**--**	**5.8**	**3.9**	**3.3**	**3.6**	**2.9**	**4.4**	**1.9**	**4.5**	**6.5[5]**	**n/a**	**6.5**	**6.5 – 7.9**

[1] Values represent concentrations as reported by OWRB (1983a), as cited in TCSTF (2000a).

[2] Comparison values are those for sites 22a and 22b on Neosho River, and 23 and 24 on Spring River (OWRB, 1983a, as cited in TCSTF, 2000a).

[3] Hardness-dependent criteria, calculated using conservative hardness value of 200 mg/L.

[4] Action level requiring treatment technology.

[5] Secondary Drinking Water Standard.

[6] Minimum values used for this parameter, rather than maximum.

Bold values indicate concentrations at least 10 times maximum concentration from comparison samples.

n/a = not available
MCL = Maximum Contaminant Level (EPA, 2002b)
ug/L = micrograms per liter
CCC = Criteria Continuous Concentration (EPA, 2002d)
uS/cm = microSiemens per centimeter
CMC = Criteria Maximum Concentration (EPA, 2002d)

3.2.3.2 Sediment Concentrations (43 C.F.R § 11.25(b)(2) and (3)(d))

Selected data illustrating the concentrations of the mining-related metals in the sediments of Tar Creek are presented in Table 4. The Upper Effect Threshold (UET) concentrations are included in Table 4 for comparison. The UET were developed in other studies that are considered to indicate a high likelihood that sediments with concentrations exceeding the UET will injure aquatic organisms exposed to those sediments (Buchman 1999).

Table 4. Summary of selected chemical concentrations in sediment samples from the Tar Creek area.

Location on Tar Creek	Parameter	Mean Concentration[1] (mg/kg)	Comparison Criteria[2] (mg/kg)
Site 7, at north boundary of Ottawa County	Lead	**526**	127
	Zinc	**8,420**	520
Site 4b, near confluence with Lytle Creek	Lead	**388**	127
	Zinc	**31,258**	520
Site 10, above Commerce	Lead	**888**	127
	Zinc	**19,907**	520
Site 20, above confluence with Neosho River	Lead	**245**	127
	Zinc	**4,457**	520
Site 22, at the mouth	Lead	**290**	127
	Zinc	**6,117**	520

[1] Concentrations as reported in the 1994 Five-Year Review for the 1987-89 sampling round (EPA, 1994).

[2] Upper Effects Threshold (UET), as listed in Buchman (1999).

Bold values indicate concentrations at least 10 times the comparison criteria.

mg/kg = milligrams per kilogram

3.2.4 Exposed Air Resources Estimates and Concentrations (43 C.F.R § 11.25(b)(2) and (3)(d))

It is likely that air continues to be a pathway by which hazardous substances are transported via fugitive dusts from waste piles during periods of high winds or when anthropogenic activities create dust into the air. The extent of the impacted air has not been established. A study showed that the average zinc concentration of 1.48 $\mu g/m^3$ was two orders of magnitude greater than that observed at a comparison site in Kansas (Oklahoma State Department of Health [OSDH] 1983). More recent data found that the average concentration of lead in dust in the air column was 739 mg/kg (E&E 1996). This was calculated by taking the average lead concentration in Total Suspended Particulates (TSP) (0.047 micrograms per cubic meter) divided by the average TSP concentration (51 micrograms per cubic meter of air).

3.2.5 Exposed Biological Resources

The plants and animals generally associated with habitats at the Site have been potentially exposed to hazardous substances released from the mining activities through the various pathways.

The U.S. Fish and Wildlife Service (USFWS) records indicate that the following species listed or candidates for listing under the Endangered Species Act may occur in the vicinity of the Tar Creek Site (USFWS 2004):

Federally listed as endangered:

- Ozark big-eared bat (*Plecotus townsendii ingens*)
- gray bat (*Myotis grisecens*)
- Ozark cavefish (*Amblyopis rosae*)
- winged mapleleaf mussel (*Quadrula fragosa*);

Federally listed as threatened:

- bald eagle (*Haliaeetus leucocephalus*)
- Neosho madtom (*Noturus placidus*);

Species that are candidates for federal listing:

- Arkansas darter (*Etheostoma cragini*)
- Neosho mucket (*Lampsilis rafinesqueana)*

State listed as endangered:

- Neosho mucket (*Lampsilis rafinesqueana*)
- Longnose darter (*Percina nasuta*)
- cave crayfish (*Cambarus tartarus*)

State listed as threatened:

- Blackside darter (*Percina maculata*)

- In addition, many other biological species do or should inhabit the Site and thus may be exposed to contamination, including:
- Other freshwater fish and invertebrates in the Neosho and Spring River watersheds
- Other resident and migratory birds

- Other resident mammals, reptiles, and amphibians
- Soil invertebrates
- Native terrestrial, riparian, and aquatic plant species

Very limited data were found regarding the concentrations of Site-related metals in the tissues of exposed biota (Aggus et al 198, TCTFHES 1983, ODEQ 2003). Fish collected from Tar Creek in the early 1980s had concentrations of lead and zinc that were higher than the fish collected from streams that were considered un-impacted by mining (Table 6). In the absence of a background study, the sites used for comparison are those located on the Neosho and Spring Rivers in the 1983 Tar Creek Task Force Health Effects Subcommittee (TCTFHES) study and in the 1993 Dames & Moore Remedial Investigation for Cherokee County, Kansas (TCSTF 2000a.) Recent studies by USFWS indicate that migratory waterfowl found in the area may be impacted by heavy metals (Beyer 2004).

Table 5. Summary of the concentrations of selected metals in fish tissue from the Tar Creek area.

Location		Parameter	Maximum Concentration (mg/kg)	Concentration range for comparison samples (mg/kg)	RBC for Subsistence Rate (mg/kg)[5,6]
Tar Creek at the mouth[1]		**Zinc**	**58.5**	**7.7 – 13.9[1,2]**	**153.8**
Tar Creek upstream of Oklahoma[3]		**Lead**	**14**	**0.24 – 2.06[3,4]**	**n/a**
		Zinc	**203**	**12.0 – 99.0[3,4]**	**153.8**
Treece Pond near Tar Creek upstream of Oklahoma[3]		**Lead**	**19.6**	**0.24 – 2.06[3,4]**	**n/a**
		Zinc	**199.0**	**12.0 – 99.0[3,4]**	**153.8**

[1] Values represent concentrations as reported by Tar Creek Task Force Health Effects Subcommittee (TCTFHES), 1983, as cited in TCSTF, 2000a.
[2] Comparison values are those for sites 22a and 22b on Neosho River, and 23 and 24 on Spring River (TCTFHES, 1983, as cited in TCSTF, 2000a.)
[3] Values represent concentrations as reported by Dames & Moore, 1993, as cited in TCSTF, 2000a.
[4] Comparison values are those for Neosho River and Spring River (Dames & Moore, 1993, as cited in TCSTF, 2000a.)
[5] RBC calculated using consumption rate recommended for subsistence fishing (EPA, 2000c).
[6] RBC values apply to the edible portion of the fish, but specific information was not available.

Bold values indicate concentrations at least 3 times maximum concentration from comparison samples.

mg/kg = milligrams per kilograms wet weight **n/a = not available**
RBC = risk-based concentration, per EPA Region III methodology and data (1999, 2002).

3.3 Potentially Affected Resources and Resource Services (43 C.F.R § 11.25(e)

Natural resources present at Tar Creek Superfund Site include land, fish, wildlife, biota, air, surface water, groundwater, and drinking water supplies. Some of these resources include threatened and endangered species, migratory birds and their habitats protected by the DOI or the State of Oklahoma

under the Federal and State species protection laws. These species exist, or formerly existed, within the Tar Creek Superfund Site.

Potentially affected trust resources include, but are not limited to:

- Groundwater of the Boone and Roubidoux Aquifers
- Surface waters and sediments of portions of the Grand Lake, Tar Creek, Neosho and Spring River Watersheds
- Geologic resources in many locations in Ottawa County including land and soils
- Air in many locations in Ottawa County
- Individually and Tribally owned Indian lands
- Mammals
- Migratory and non-migratory birds
- Resident fish species
- Aquatic invertebrates
- Soil invertebrates
- Amphibians and reptiles
- Riparian, terrestrial, and aquatic plant species
- Riverine, riparian, lacustrine, and wetland habitats

The services that the Trustees believe have been impaired or lost from injuries to these resources from releases at the Tar Creek Site include, but are not limited to:

- Agricultural production, plant habitat, native plants, and shallow groundwater for drinking water, crop irrigation, and household and industrial uses
- Native plants as food or medicinal resources (e.g. persimmon, mushrooms, watercress, mulberry, blackberry, snakeroot).
- Recreational and subsistence hunting of game mammals, game birds, aquatic turtles and bullfrogs
- Non-consumptive recreation, e.g., camping and wildlife observation, due to reduced quantity of natural habitats
- Recreational and subsistence fishing and shell fishing
- Beneficial uses of surface waters including public and private drinking water, fish and wildlife propagation, recreation (swimming, fishing), and agriculture

- Beneficial uses of ground water including drinking water, irrigation for plants and other uses
- Wetland and riverine habitat functions such as fish and wildlife propagation, nutrient cycling, and contaminant sequestration
- Native American historical cultural and subsistence uses, e.g., native plants, aquatic resources, birds, migratory birds, mammals, and reptiles as sources of food, medicine, and crafts

If not for mining/milling wastes and contamination associated with mining activities, several thousands of acres would be suitable habitat for fish, fowl, and game, and utilized by Native Americans and other Oklahoma citizens for hunting and gathering and/or ranch and farmlands. Currently, many tribal members and non-Indian citizens of Oklahoma no longer utilize resources in the area because they are not present or because those resources are contaminated (Seneca-Cayuga Tribe 1999a). Certainly, for the Native American citizens living within the Tar Creek Site, much of the approximately 40 sq. mile area is lost for traditional uses. Some of the adverse changes are to grazing, farming, hunting, fishing, and gathering practices (Seneca-Cayuga Tribe 1999a).

4.0 REMEDIATION AND RESPONSE ACTIONS TAKEN OR PLANNED

Response actions at the Site were initiated in June of 1980, when the Governor of Oklahoma formed a Task Force to investigate and address the acid mine water discharges. The primary concerns identified were the observed contamination of Tar Creek surface water and the potential for contamination of the Roubidoux aquifer, the primary drinking water supply in the area. The data developed for the Task Force was used by the EPA to prepare the Hazard Ranking System score for the Site, which led to the NPL listing in 1983.

As noted above, the EPA has designated four Operable Units (OUs) at the site. A ROD for OU 1 was signed in 1984 and was intended to prevent further degradation of surface water at the Mayer Ranch and at Douthat Bridge areas in the Tar Creek drainage. The ROD called for reduction or elimination of recharge to the Boone aquifer by diking, building diversion structures, and plugging mine shafts to stop the surface water of Tar Creek from entering the two collapsed mine shafts in Kansas that were identified as major inflow points (EPA 1984). In Oklahoma, a mineshaft was plugged and a berm was constructed to divert Lytle Creek away from possible inflow points. To prevent further migration of acid mine water to the Roubidoux, a total of 83 abandoned deep wells were plugged. Initial construction activities were concluded on December 22, 1986, but wells, shafts and boreholes continue to be plugged by ODEQ, as they are discovered. Shaft related collapses in the area continue to occur (Luza 1986).

After-action monitoring begun in 1987 to assess the effectiveness of the diking, diversion work, and well plugging, demonstrated that the OU 1 remedy was ineffective in mitigating the environmental degradation of the surface waters of Tar Creek drainage basin; however, no further remedial actions has been recommended by the EPA (EPA 1994, EPA 2000a). The Trustees have requested EPA to consider review of the effectiveness of OU 1 (Oklahoma Trustee Council 2003). There is continued monitoring of the water in the mines, the groundwater, and the surface waters show that the releases are continuing (EPA 2000a).

The EPA signed a second ROD on August 27, 1997 to address the soil contamination in residential areas, OU 2 (EPA 1997). Remediation of residential properties began in June 1996 as an EPA removal action and transitioned to a remedial action in January 1998. The EPA reports that more than 2,000 residential properties, day cares, schools, parks, and business properties in the five-city mining area have been remediated through this work. Remediation of the remaining residential area properties continues as properties are identified (EPA 2000a).

OU 3 consisted of an emergency removal from the Eagle-Picher field offices and workshop in Cardin, Oklahoma. The BIA along with the Quapaw tribe requested and received assistance from EPA for a removal action. EPA removed 117 containers filled with numerous laboratory chemicals. The removal action was completed in 2000 (BIA 2004).

OU 4 addresses certain contamination from former mining and mill residues, and smelter wastes deposited at the site by former mining-related operations. OU4 is specific to the chat piles, chat bases and mill floatation ponds in the Picher Field area. The Administrative Order on Consent (AOC) was signed in December 2003. The RI/FS will begin in 2004. The full extent of the release of heavy metal contamination associated with former milling wastes has not been completely assessed and at this time, it is unknown what remedial actions will occur under OU4.

5.0 PRELIMINARY DETERMINATION REGARDING PREASSESSMENT SCREEN CRITERIA

The following sections summarize the information evaluated in order to develop a preliminary determination by the Trustees, which is presented in Section 6.0 (43 C.F.R § 11.23(e)).

5.1 Criterion 1 – A release of a hazardous substance has occurred. (43 C.F.R § 11.23(e)(1))

It has been documented that the Tar Creek Site covers approximately 40 square miles where underground mining was performed at hundreds of mines and areas downstream from the mining where hazardous substances have been released. These hazardous substances were released as a result of lead and zinc mining and milling at the Tar Creek Site and include, but may not be limited to, metals that are listed as hazardous substances (42 U.S.C. 9601§101(14)) and that are known to be toxic to fish and wildlife. Direct release of hazardous substances into the environment began in the late 1800s, and releases continue to occur from unprotected chat piles and sediment in former millponds, acid mine water, contaminated groundwater, and contaminated surface waters, including sediments.

5.2 Criterion 2 – Natural resources for which the Trustees may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the release. (43 C.F.R § 11.23(e)(2))

Tables 1 through four present selected sampling data for soils, and water that show impacts to natural resources.

The exposed areas and resources that have been or are likely to have been adversely affected by releases at the Tar Creek Site are under the trusteeship of the Trustees, as defined by CERCLA. The above listed Indian Tribes, which are located within areas that are impacted or potentially impacted by the release of hazardous substances, act as Trustees for natural resources, including their supporting ecosystems, that belong to, are managed by, are controlled by, or appertain to the respective Indian Tribe, or which are

held in trust for the benefit of such Indian Tribe or belong to a member of such Indian Tribe if such resource is subject to a trust restriction on alienation. (42 U.S.C. § 9607(f)) and (40 CFR § 300.610). The State of Oklahoma, through the Oklahoma Secretary of Environment, acts as a natural resource Trustee on behalf of the public for natural resources, including their supporting ecosystems, at the Tar Creek Site within the boundary of the State or which belong to, are controlled by, are managed by, or appertain to the State. (42 U.S.C. § 9607(f)), (40 CFR § 300.605) and (27A Okl. St. Ann.1-2-101). The Secretary of Interior acts as a natural resource Trustee for natural resources at the Tar Creek Site, which are managed or controlled by the U.S. Department of Interior. (42 U.S.C. § 9607(f)) and (40 C.F.R. §300.600).

Documented exposure pathways exist from the source of releases to Trustee resources, including, but not limited to lands, groundwater, surface water (including sediments), soils, and air. Potential exposure pathways also exist from exposed and contaminated soils, surface waters, sediments, and air to biological and cultural resources.

5.3 Criterion 3 – The quantity and concentration of the released hazardous substance is sufficient to potentially cause injury to natural resources. (43 C.F.R § 11.23(e)(3))

5.3.1 Potential Soils Injury

According to the NRDA regulations, an injury to the soils (geologic) resource has resulted from the release of a hazardous substance if the concentrations of those substances in soils are sufficient to have caused injury to surface water, air, biological resources, or groundwater; or are elevated enough to be toxic to soil invertebrates, plants, or other biota (43 CFR § 11.62(e)).

As shown in Table 1 the concentrations of mining-related metals in the chat, floatation pond sediment, and residential soils exceed the toxicity reference values for plants, soil invertebrates, and mammals. These exceedances indicate a potential for injury to a variety of biota that would be exposed. The chat piles and residual millponds are still un-vegetated or the natural vegetation has not recovered decades after the cessation of active mining. Metals laden chat and soils have been placed or washed into surface water at the site causing elevated levels or metals in the surface water and elevated pH levels (as shown in Table 3). Contaminated surface water contributes to contamination of groundwater within the mine pool (McCuskey 1935). Where chat-soil media do support plant life, elevated concentrations of metals depositing on plant may be a potential source of exposure to biota and humans.

5.3.2 Potential Groundwater Injury

According to the NRDA regulations, an injury to the groundwater resource has resulted from the release of hazardous substances if concentrations of those substances exceed drinking water standards, as established by Sections 1411-1416 of the Safe Drinking Water Act (SDWA) or by other federal or state laws or regulations that establish such standards for drinking water, in groundwater that was potable before the discharge or release (43 CFR § 11.62(c)).

Injury to groundwater also results when concentrations of hazardous substances are sufficient to have caused injury to surface water, air, or geological or biological resources, when exposed to groundwater (43 C.F.R. 11.62(c)(iv). The historical and on-going monitoring of groundwater in mineshafts, boreholes, and other wells have demonstrated continuous concentrations of mining-related constituents, including a number of metals, that exceed relevant Federal and State of Oklahoma drinking water standards (OWRB 1983c, Christenson 1995). Examples of these concentrations were presented in Table

2. In addition, the discharge of the contaminated groundwater to local surface waters from mine openings is considered the major sources of contamination to those surface waters (TCSTF 2000a). As noted below, the discharges of groundwater are sufficient to result in injury to surface waters, and potentially to biota that might be exposed via absorption or ingestion. (OWRB 1983)

5.3.3 Potential Surface Water Injury

According to the NRDA regulations, an injury to the surface water resource results from the release of a hazardous substance if concentrations and duration of substances exceed applicable water quality criteria established by Section 304(a)(1) of the CWA, or by other federal or state laws or regulations that establish such criteria, in surface water that before the discharge or release met the criteria and is a committed use as a habitat for aquatic life, water supply, or recreation (43 CFR § 11.62(b)).

5.3.3.1 Water

Acid Mine Discharges

The available monitoring data indicate that overall the contaminant concentrations in the acid mine discharges have decreased over time (USEPA 1994, TCSTF 2000a). However, the concentrations still exceed Federal and State of Oklahoma water quality criteria for drinking water and for the protection of aquatic life, as the data in Table 3 and the BUMP report data cited earlier demonstrate. Oklahoma surface water quality standards are hardness dependant. The standards are at least as stringent as Federal standards.

Contaminated Runoff from Tailings Piles

The results from the limited sampling of leachate from tailing piles indicate waters flowing at these sites had low pH and contained concentrations of the mining-related metals that exceed Federal (EPA) and State of Oklahoma water quality criteria for drinking water and for the protection of aquatic life (OWRB 1983c) (TCSTF 2000a).

The majority of the mine wastes are situated within the Tar Creek watershed, but some are located elsewhere. These wastes are unconfined and thus subject to leachate formation, but the overall extent of injuries potentially associated with this source has not been fully assessed (TCSTF 2000a).

Streams and Lakes

The concentrations of metals and other mining-related constituents in the Tar Creek watershed frequently have and continue to exceed relevant Federal (EPA) and State of Oklahoma water quality standards and criteria for drinking water and for the protection of aquatic life, as demonstrated in Table 3, above. The beneficial uses assigned to Tar Creek, including aesthetics and habitat-limited aquatic community, are not being achieved (USEPA 1994). At least one fish kill has been observed (Suttles 1980), and a number of toxicity tests using water and sediments from Tar Creek and from downstream areas have demonstrated toxicity to fish and invertebrates (Ayers 1990, McCormick and Burks 1987). While further testing is needed to determine how much of Tar and Lytle creeks have been so impacted that they support no life, it is likely that instream community structure consists of only tolerant organisms and/or species that are able to either seek refuge within the stream or relocate.

Water quality information from the Spring River and Neosho River showed elevated concentrations of metals, but these data are insufficient to support rigorous evaluations. The concentrations of zinc have been observed to exceed water quality standards in the Neosho River below the confluence with Tar Creek (TCTFHESC 1983).

5.3.3.2 Sediment

Screening concentrations for inorganic and organic contaminants in freshwater sediments have been compiled and published by the National Oceanic and Atmospheric Administration (NOAA). For the purpose of identifying the potential for injury to sediments, and to aquatic organisms exposed to those sediments, concentrations of hazardous substances in bulk sediment samples collected from the potentially impacted reaches of Tar Creek and other areas were compared to "upper effects threshold" values published by the NOAA. Upper Effect Thresholds (UETs) represent concentrations above which adverse effects to aquatic organisms are always expected to occur as a result of exposure to a particular contaminant (Buchman 1999). However, adverse effects may occur at concentrations lower than the UETs, and future, more detailed assessments may use other threshold values as appropriate.

As the data presented in Table 4 demonstrate, the concentrations of at least some mining-related metals exceeded the UETs at all locations sampled in Tar Creek. In addition, the UETs were also exceeded in the sediments of Grand Lake (McCormick and Burks 1987). Sediments from Tar Creek and the Neosho River were toxic to aquatic organisms in laboratory tests (McCormick and Burks 1987). The potential contamination of the sediments of Grand Lake is a continuing concern because the verified biological availability of metals in the influent (TCSTF 2000a)..

5.3.4 Potential Air Injury

According to the NRDA regulations, an injury to the air resource has resulted from the release of a hazardous substance if the concentrations of emissions from the release are in excess of standards for hazardous air pollutants established by section 112 of the Clean Air Act, 42 U.S.C. § 7412, or by other Federal or State air standards established for the protection of public welfare or natural resources. In addition, injury to air has occurred if the concentrations and duration of emissions are sufficient to have caused injury to surface water, groundwater, geologic, or biological resources when exposed to the emissions (43 CFR § 11.62(d)).

Lead is the only Site-related metal for which a National Ambient Air Quality Standard (NAAQS) exists, 1.5 micrograms per cubic meter (maximum quarterly average). The observed concentrations of lead in air have not exceeded this standard. However, there is a possibility that dust emissions and subsequent fall out have contributed to the injury to soils and surfaces at the Site.

5.3.5 Potential Biota Injury

According to the NRDA regulations, an injury to a biological resource has resulted from the release of hazardous substances if concentration of those substances is sufficient to cause the biological resource or its offspring to have undergone at least one of the following adverse changes in viability: death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations (43 CFR § 11.62(d)). Table 1 lists concentrations of metals in soils from the area and appropriate comparison values, called "Threshold Reference Values" (TRV) for plants earthworms and mammals.

In addition, an injury has occurred if the concentrations of the substances that were released accumulate in the tissues of biota to the extent that they exceed action or tolerance levels established under section 402 of the Food, Drug and Cosmetic Act, 21 U.S.C. § 342, in edible portions of organisms; or exceed concentrations for which an appropriate State health agency has issued directives to limit or ban consumption of such organism (43 CFR § 11.62(d)).

There are currently no action levels established for the primary mining-related metals, and there are no federal or state restrictions on the consumption of fish or wildlife from the Site. However, the DEQ

(DEQ 2003) has issued an advisory limiting fish consumption in the Spring and Neosho Rivers as well as ponds in the area.

The available information documents potential injury to terrestrial plants in the areas with mining wastes, and of fish and aquatic invertebrates in Tar Creek. Although the data are currently lacking, the concentrations of mining-related constituents in the water and sediment have potential to cause continued injury to aquatic biota. These constituents have been, and are still being, released to surface water throughout the mined areas, as well as downstream of those areas.

Similarly, because of the high concentrations of toxic substances in the soils and water at the Site, it is likely that injury to other biological resources, including soil invertebrates, birds, and mammals, can be documented with additional study.

5.4 Criterion 4 – Data sufficient to pursue an assessment are readily available or are likely to be obtained at a reasonable cost. (43 C.F.R § 11.23(e)(4))

A substantial amount of information pertaining to the injury of natural resources currently exists for the Tar Creek Superfund Site. This data was obtained by the EPA, USGS, and OWRB and other entities and is available in reports in the public document depository at the EPA, the DEQ and the Miami Public Library or in files of the various agencies. The Trustees believe this data is sufficient to preliminarily establish injury to soils, groundwater, and surface water resources for the period of 1980 through 2000 for resources affected by releases from the Tar Creek Site. Monitoring of continuing releases to some of these resources continues. These data have not been systematically collated and interpreted to determine if they are sufficient to quantify the injuries to these resources.

Data sufficient to determine and quantify injuries to other Trustee resources, including biological and cultural resources, may not currently exist. For injuries to the abiotic and biological resources, the Trustees believe that additional information, if necessary, can be obtained at a reasonable cost. Currently, several mining companies and the Department of Interior have funded additional work to characterize the non-residential portions of the Tar creek site for Operable Unit 4 at a cost of $2,000,000. Additional assessment work will be required but can be contracted for less than the amount of anticipated damages based on currently funded studies by DOI, DEQ and the tribes. Costs are generally considered reasonable if the anticipated cost of the assessment is expected to be less than the anticipated damage amount determined in the injury quantification and damage determination phases (43 CFR § 11.14).

5.5 Criterion 5 – Response actions carried out or planned do not or will not sufficiently remedy the injury to natural resources without further action. (43 C.F.R § 11.23(e)(5))

Response actions carried out thus far or planned to date will not sufficiently remedy the injury to natural resources affected by releases from the Tar Creek Site. Response actions carried out to date as part of the acid mine discharge remedial action (OU 1) have not been, and are not expected to be sufficient to remedy injuries to natural resources affected by releases of acid mine drainage (EPA 1997, EPA 2000a). Response actions completed to date to remove contaminated mine wastes and soils from residential and other properties with high human use have not addressed other locations with contaminated mine wastes. The EPA is currently in the process of conducting an RI/FS to evaluate potential remedial alternatives for additional chat piles, chat bases and millpond wastes. Because final the CERCLA remedies for OU4 have not been decided or implemented, the ability of the remedy to address the injury to natural resources is undetermined. However, due to the narrow scope OU4 the remedy will not address

downstream contamination and therefore will not sufficiently remedy the injury to natural resources without further action. Response actions have not addressed methods to improve groundwater quality.

6.0 DETERMINATION

The Trustees have determined that current information indicates that there is a reasonable probability of making a successful natural resources damage claim pursuant to 42 U.S.C. § 9607 and 33 U.S.C § 1321 and that all criteria and requirements at 43 CFR Part 11, generally, and 43 CFR § 11.23(a)-(g), § 11.24 and § 11.25, specifically, have been satisfied. The Trustees also have determined that further investigation and assessment is warranted and should be carried out at this site in accordance with Federal Regulations at 43 CFR § 11, Subparts C and E.

The information provided and conclusions made in this Preassessment Screen shall be used to direct further investigations and assessments and is not intended to preclude consideration of other resources later found to be affected or other parties found to be responsible for releases.

APPENDIX A

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FIGURES
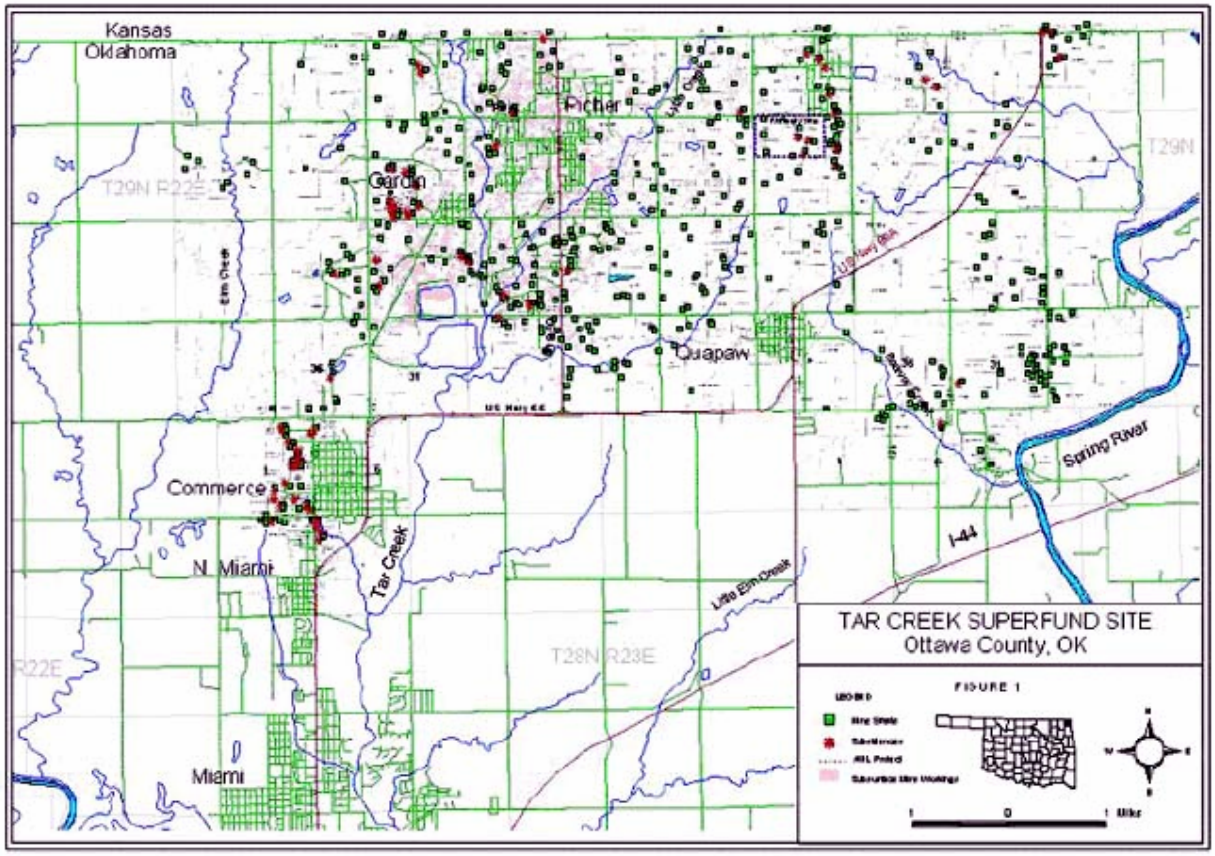
Figure 1. General Location Map