Technical Assistance Services *for* Communities

Tar Creek Superfund Site, Operable Unit 5

Review of Tar Creek Superfund Site Operable Unit 5 Human Health Risk Assessment, Ver. 1.1

The community group Local Environmental Action Demanded (LEAD) asked for assistance from EPA's Technical Assistance Services for Communities (TASC) program. The request was for TASC review and comment on Version 1.1 of the Tar Creek Superfund Site Operable Unit 5 Human Health Risk Assessment (HHRA). The HHRA evaluates potential risks to people from possible current and future exposure to metals at operable unit 5 (OU5). The HHRA Report has an executive summary, seven chapters and six appendices. The chapters are:

1. Introduction
2. Site Characteristics and Potential Receptors
3. Data Evaluation
4. Exposure Assessment
5. Toxicity Assessment
6. Risk Characterization
7. References

This fact sheet covers the first six chapters. TASC comments on the HHRA follow the summary.

EPA asked for comments on the HHRA by July 17, 2020. <u>Please email comments to EPA community involvement coordinator Janetta Coats at coats.janetta@epa.gov</u>.

The U.S. Environmental Protection Agency's (EPA's) TASC program funded this fact sheet. Its contents do not necessarily reflect the policies, actions or positions of EPA.

1. Introduction

This section discusses the purpose, applicable regulations and scope of work for the HHRA. It lists several guidance documents used to prepare the HHRA. The list includes reports on traditional tribal exposure scenarios.

2. Site Characteristics and Potential Receptors

This section describes the Tar Creek Superfund site. It also describes the land and water use in the OU5 Study Area. OU5 is the sediments and water in continuously flowing creeks, streams and rivers that may be affected by historical mining activities in the Oklahoma portion of the Tri-State Mining District and upstream portions in Kansas and Missouri. The OU5 Study Area includes seven watersheds that flow from Kansas and Missouri into Oklahoma. The watersheds are Fourmile Creek (a background area not affected by mining), Elm Creek, Tar Creek (including Lytle Creek), Neosho River, Beaver Creek, Lost Creek and Lower Spring River (downstream of Empire Lake in Kansas). See Figure 1.

The Tri-State Mining District is an area of widespread lead and zinc mining across the Tri-State region of Kansas, Missouri and Oklahoma. Tar Creek is one of four mining-related Superfund sites in this area.

Potential receptors are people who may come in contact with site-related chemicals. Exposures were evaluated for three different groups. The groups were the tribal lifeway (adults and children following traditional tribal practices), aquatic workers (fish hatchery or environmental

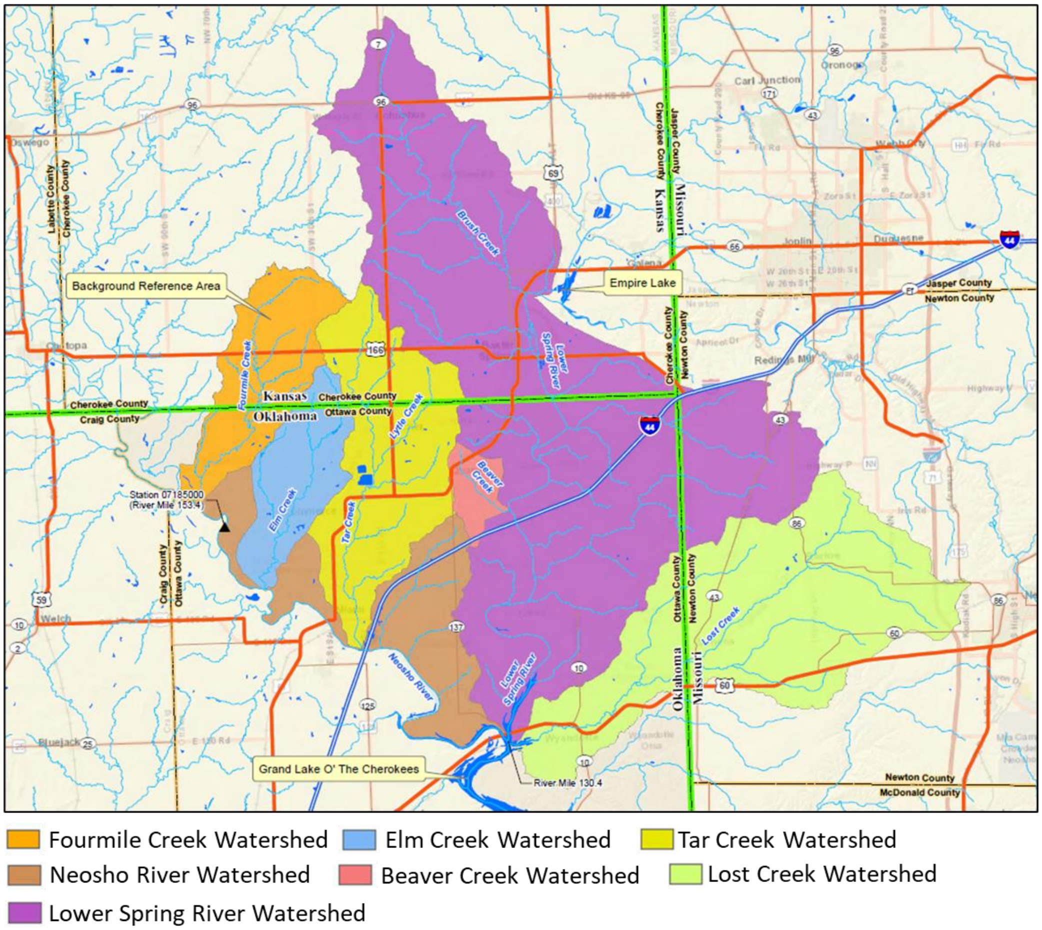

Figure 1. OU5 Study Area Watersheds (adapted from Figure 1-2 of the OU5 Remedial Investigation Report)

employees), and the general public (adult and child recreational users).

Exposure to contaminated water and sediment in rivers and creeks and in aquatic plants and animals used as food were considered for the tribal lifeway. Exposure to contaminated water and sediment in rivers and creeks and in fish used as food were considered for the general public. Exposure to contaminated water and sediment in rivers and creeks during work was considered for aquatic workers.

Tribal lifeway exposures include:

- Exposure to water and sediment in rivers and creeks during hunting, fishing, gathering aquatic plants, swimming and wading.
- Using river or creek water for drinking and bathing.
- Using water from rivers or creeks in sweat lodges.
- Eating fish, shellfish, aquatic plants, amphibians/aquatic reptiles and semi-aquatic mammals.
- Using aquatic plants to make salve.

General public exposures include:

- Exposure to water and sediment in rivers and creeks during hunting, fishing, swimming and wading.
- Using river or creek water for drinking and bathing.
- Eating fish.

Aquatic worker exposures include:

- Exposure to water and sediment in rivers and creeks during work activities.

Exposure to areas of mine discharge was also evaluated for the tribal lifeway and general public. EPA used the same exposure assumptions used for creek and river water, although EPA considers exposure to mine discharge to be very limited. This

Definitions

Chemical of Potential Concern (COPC) – Contaminants with the greatest potential to cause adverse human health effects if people come in contact with them.

Chemical of Concern (COC) – A contaminant that poses an unacceptable risk to human health and the environment, as identified by EPA's Superfund risk assessment process.

Exposure Point Concentration (EPC) – The average concentration of a chemical that a person would be exposed to by contact with a certain medium (for example, soil, sediment, plant, animal tissue) in a certain location.

Hazard Quotient (HQ) – The ratio of exposure to a chemical over a specified period to a toxicity value for a similar exposure period.

Hazard Index (HI) – The sum of hazard quotients for substances (e.g., chemicals) that affect the same target organ, organ system or whole body.

exposure is considered very limited because of its intermittent and low flow as well as its relative inaccessibility. Appendix F of the HHRA Report presents mine discharge results.

3. Data Evaluation

This section describes the data used in the HHRA. It also describes how data were grouped and how chemicals were selected for the HHRA. Data in the HHRA are from investigations from 2000 to 2017. All sediment and tissue samples from 2017 were tested for a set of 19 metals. Water samples were also tested for five other metals (calcium, magnesium, potassium, sodium and molybdenum). All of these chemicals except molybdenum are also essential nutrients. Earlier samples were tested for various metals that may have been different than the 2017 tests. Some earlier samples were only tested for cadmium, lead and zinc.

Not all chemicals tested for were selected for use in the HHRA. Chemicals that are essential nutrients were not included in the HHRA results. For the general public, EPA also looked at whether a chemical was present in sediment and water at concentrations above EPA's regional health-based screening levels for residential soils and drinking water. Health effects for the general public are not expected for chemicals in sediment or water below these regional screening levels.

EPA first identified a list of chemicals of potential concern (COPCs). After the remaining HHRA steps (summarized below), EPA updated the list of COPCs to reflect a smaller list of chemicals that make up the highest health risk, are present at concentrations above background, and are associated with mining activities. This shorter list is known as the final chemicals of concern (COCs). The COCs are the focus of site cleanup activities.

Table 1 (see page 4) shows the final list of COCs used in calculating final HHRA results. The table shows the COCs across different watersheds and for different receptors (tribal lifeway [TL], aquatic worker [AW] and general public [GP]). Blank or empty spaces in any row mean the chemical is not a COC for the watershed listed in the column heading. Cadmium, lead and zinc are COCs in the sediments of Elm Creek, Tar Creek and Beaver Creek, and in the waters of Elm Creek and Tar Creek. Lead is a COC in the sediments of Lower Spring River, and cadmium and lead are COCs in the waters of Beaver Creek. A few other chemicals are also COCs in creek and river water. There are no COCs for Lost Creek.

Biota (plant and animal tissue) were evaluated only on a sitewide basis. Biota COCs are in the first column of Table 1. Cadmium, lead, zinc, barium, copper, nickel and silver are COCs for plant and animal tissue eaten in the tribal lifeway. Only lead is a COC for animal tissue (fish) eaten by the general public. The HHRA assumes the general public does not gather aquatic plants for eating or medicine.

Table 1. Final COCs for Tar Creek OU5 (from Table 6-14 of HHRA Report)

Final COCs	Sitewide (Biota Only)	Elm Creek	Tar Creek	Neosho River	Beaver Creek	Lost Creek	Lower Spring River
Sediment							
Cadmium		TL	TL, AW		TL		
Lead		TL, AW, GP	TL, AW, GP		TL, GP		TL, GP
Zinc		TL	TL		TL		
Surface Water							
Antimony		TL					
Arsenic			TL, AW, GP				
Barium				TL			
Cadmium		TL, AW, GP	TL, GP		TL		
Cobalt			TL, AW, GP		TL		
Iron			TL, GP	TL			
Lead[a]		TL, GP	TL, GP		TL, GP		
Manganese			TL, AW, GP				
Nickel		TL	TL, AW		TL		
Zinc		TL	TL				
Biota[b]							
Barium	TL						
Cadmium	TL						
Copper	TL						
Lead	TL, GP						
Nickel	TL						
Silver	TL						
Zinc	TL						

Notes

a. Lead in surface water was not evaluated for aquatic workers because of the limitations of the model.

b. Biota are plants and animals. Final COCs were identified based on sitewide dataset.

AW = Aquatic Worker

GP = General Public

TL = Tribal Lifeway

4. Exposure Assessment

This section talks about how people might come in contact with chemicals at the site. It includes identification of exposure pathways and calculation of exposure point concentrations (EPCs). EPCs are the average amounts of a chemical that people would be exposed to in water, sediment and biota. It also identifies exposure factors. These are assumptions used to calculate the amount of a chemical that might get inside a person's body. It also estimates the amounts of chemicals people take into their bodies by eating, drinking, breathing and having skin contact with them.

The HHRA calculated risks for two age groups, child (ages 0 to 6) and adult, for the tribal lifeway and general public scenarios. Only adults were looked at under the aquatic worker scenario.

EPC estimates used sediment and water sampling results for each watershed. EPCs were estimated for mine discharge for the Beaver Creek and Tar Creek watersheds. EPCs were estimated using sitewide data for tribal lifeway exposures to all aquatic plants (duckweed and arrowroot) and each type of animal (fish, shellfish, bullfrog and raccoon) as well as the general public's exposure to fish.

5. Toxicity Assessment

The toxicity assessment estimates how toxic or poisonous a chemical is when ingested (eaten), inhaled (breathed) or absorbed through the skin. This section describes the sources of toxicity values for the chemicals. EPA used its standard toxicity sources for ingestion and inhalation. EPA estimated dermal absorption (absorption through the skin) toxicity by using ingestion toxicity factors and assumptions for absorption of chemicals through the stomach and intestines.

6. Risk Characterization

This section describes the methods used to describe noncancer hazard and cancer risk by using information from the exposure and toxicity assessments. It discusses numerical estimates of hazard and risk and the uncertainties associated with the HHRA.

EPA calculated noncancer health risk by comparing a person's estimated intake of a chemical with a dose not expected to cause a health effect. This dose is called the reference dose. The result for each chemical is called a hazard quotient (HQ). An HQ equals chemical intake divided by the reference dose. The reference dose is either an oral or an inhalation dose, depending on how the chemical enters the body. When an HQ is greater than 1, there is a possibility for a negative health effect from exposure to that chemical. All HQs for similar health effects are added together to calculate a total hazard index (HI). The HI may exceed 1 even if all individual HQs are less than 1. If the HI is less than 1, the total noncancer risk is not expected to cause a negative health effect.

EPA calculated cancer health risk by estimating the excess lifetime cancer risk from exposure to each chemical. As with the noncancer HI, cancer risks were added together to estimate overall cancer risk from all exposures to chemicals. EPA usually considers the need for cleanup options when cancer risks are greater than 1 in 10,000 (10^{-4} or 1.E-04). EPA usually does not require cleanup actions when cancer risks are less than 1 in a million (10^{-6} or 1.E-06).

Toxicity values for evaluating cancer risks and noncancer hazards have not been developed for lead. As a result, EPA handles the risk calculations for exposure to lead differently through use of blood lead models. EPA's current policy is to reduce lead exposure levels so that there is no more than a 5% chance that children exposed to lead will have a blood lead level of 10 micrograms per deciliter (µg/dL). There is recent evidence of negative health effects from lower blood lead levels. As a result, EPA also evaluated lead exposure using two additional target blood lead levels (5 µg/dL and 8 µg/dL).

Tables 6-1 through 6-5 in the HHRA Report present HIs and cancer risks for each watershed based on COPCs. Tables 6-15 through 6-19 in the HHRA Report present the final HHRA results based on COCs, except for modeled blood lead levels. Appendix E of the HHRA Report presents the modeled blood lead level results.

Key HHRA findings are summarized below, highlighting noncancer total HI greater than 1 and cancer risks greater than 1.E-04 (or 1 in 10,000):

Tribal Lifeway Risks

- One of the greatest risks of noncancer health effects for tribal members is from inhalation of water vapor while using water from Elm Creek, Tar Creek and Beaver Creek for sweat lodges.
- For some watersheds, the greatest risk of noncancer health effects for tribal members is from eating aquatic plants from impacted creeks in OU5. Eating shellfish also increases noncancer health risks.
- Using water from Elm Creek, Tar Creek and Beaver Creek for drinking and bathing significantly increases noncancer health risks.
- People have a higher risk of noncancer health effects from contaminants in Elm Creek, Tar Creek and Beaver Creek due to hunting, fishing, gathering and recreational activities.
- The excess lifetime cancer risk from exposure to water in Tar Creek is 7 in 1,000. Drinking water from the creek and using it in sweat lodges are responsible for the greatest risks.
- The excess lifetime cancer risk for Elm Creek and Beaver Creek is 5 in 10,000, due to the use of creek water in sweat lodges.

Aquatic Worker Risks

- The aquatic worker has an increased risk of noncancer health effects from contaminants in Elm Creek and Tar Creek due to accidental ingestion and skin contact with contaminants.

- Tar Creek poses a 1 in 10,000 excess lifetime chance of getting cancer for aquatic workers.

General Public Risks

- The general public has an increased risk of noncancer health effects if people use water from Elm Creek or Tar Creek for drinking or bathing.
- The general public's excess lifetime cancer risk from swimming and wading in Tar Creek is 4 in a million. It is 7 in 10,000 from using Tar Creek water for drinking and bathing.

Risks to Children and Fetuses from Lead

- Based on default assumptions, the Integrated Exposure Uptake Biokinetic (IEUBK) blood lead model predicted that more than 5% of children exposed to lead in all impacted OU5 watersheds, except Neosho River and Lost Creek, could have a blood lead level greater than 5 micrograms per deciliter (µg/dL). It also predicted that more than 5% of children exposed to lead in the Elm Creek and Tar Creek watersheds could have blood lead levels greater than 10 µg/dL. Additional analysis of lead exposure accounting for difference in exposure frequency and time between OU5 and residential setting did not impact this risk outcome.
- The Adult Lead Methodology (ALM) blood lead model estimated that more than 5% of fetuses of aquatic workers exposed to lead in the Elm Creek and Tar Creek watershed could have blood lead levels greater than 5 µg/dL. More than 5% of fetuses of aquatic workers exposed to lead in the Elm Creek watershed could have blood lead levels greater than 10 µg/dL.
- In Appendix E, Table 6 of the HHRA Report, an additional analysis using high-end exposure assumptions for tribal lifeway, EPA estimates very high blood lead levels, from 126 µg/dL to 142 µg/dL, for tribal children exposed to lead in the reference area (Fourmile Creek) and all six impacted watersheds in OU5. EPA notes in the report that these results do not reflect the actual magnitude of the risk. The lead models have not been proven to be accurate above blood lead levels greater than 30 µg/dL. The HHRA Report concludes that lead cleanup goals should be developed as part of the upcoming feasibility study. Results for Neosho River and Lost Creek sediment and water, and Lower Spring River water, are flagged as not statistically different from the results for the background area (Fourmile Creek).

Mine Discharge Results

Mine discharge results for Tar Creek and Beaver Creek exceeded acceptable cancer and noncancer risk levels for the tribal lifeway. They were below acceptable risk levels for the general public, assuming the same type and duration of exposures as for creek water.

This section also discusses the uncertainties of the HHRA results. It concludes that while it is possible the HHRA underestimates health risk, it is more likely that it overestimates health risk.

Table 2 summarizes HHRA results by watershed. Page 9 lists results for the tribal lifeway, aquatic workers and the general public.

Table 2. Summary of HHRA Results, by Watershed

Watershed	Tribal Lifeway	Aquatic Worker	General Public
Elm Creek	+	+	+
Tar Creek	+	+	+
Neosho River	+	-	-
Beaver Creek	+	-	+ [b]
Lost Creek	+ [a]	-	-
Lower Spring River	+ [b]	-	+ [b]

Notes:
[a] Risk from eating OU5 Area plants and animals only.
[b] Risk of high blood lead level only.
+ = increased health risk.
- = no increased health risk.

TASC Comments

TASC comments are for LEAD members and the community to support understanding of site conditions and improve communication with EPA. TASC does not provide comments directly to EPA on behalf of LEAD or the community. People who live and work near the site are best equipped to share their own concerns.

- HI and cancer risk results reported in Tables 6-1 through 6-5 in the HHRA Report are based on preliminary COCs. Preliminary COCs include chemicals present at levels that are below background, as shown in Tables 6-6 through 6-13. Tables 6-15 through 6-19 show HHRA results for final COCs. Comparing results for preliminary COCs to results for final COCs indicates that background levels of metals in the Neosho River, Lost Creek and Lower Spring River may be high enough to possibly cause adverse health effects. *Since EPA typically does not clean up Superfund sites to below background levels, community members may want to ask EPA how significant health risks from background levels will be handled and communicated to the public.*

- The only COCs identified for the Neosho River are barium and iron in water. There are no COCs identified for Lost Creek. The only COC identified for the Lower Spring River is lead in sediment. *Community members may want to ask EPA if any remedial actions will be considered for these rivers.*

- The Technical Review Workgroup Lead Committee commented that "exposure to metal contaminants in river water through sweat lodge use may be a complete pathway; however, the lead (dissolved or suspended in particulates) would not be vaporized (only the water) so the inhalation and dermal exposures to lead during sweat lodge use are likely to be negligible relative to intakes from using that surface water as a source of drinking water." Yet, sweat lodge inhalation is one of the two greatest contributors to the noncancer and cancer health risks for the tribal lifeway. *Community members may want to ask EPA if other metals besides lead will also not evaporate and contribute to inhalation exposure. If this is the case, community members may want to ask EPA whether this is reflected in the final sweat lodge health risks.*

- In calculating exposure to sediment, EPA assumed that children would get sediment on their heads, hands, forearms, lower legs and feet. EPA assumed adults would get sediment on their heads, hands, forearms and lower legs but not on their feet. *Community members may want to ask EPA why adults will get sediment on their heads but not their feet.*

For More Information, Please Contact:

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EPA asked for comments on the HHRA Report by July 17, 2020. Please email comments to Jannetta Coats.

HHRA Results Summary

Tribal Lifeway Risks

All Watersheds (based on sitewide assessment for biota)

- Increased risk of noncancer health effects from:
  - Eating aquatic plants.
  - Eating shellfish.

Elm Creek, Tar Creek, Neosho River and Beaver Creek

- Increased risk of noncancer health effects from:
  - Using creek or river water for sweat lodges.

Elm Creek, Tar Creek and Beaver Creek

- Increased risk of noncancer health effects from:
  - Hunting, fishing, gathering and recreation activities.
  - Using creek water for drinking and bathing.
- Greater than a 1 in 10,000 chance of an extra case of cancer from:
  - Using creek water for sweat lodges.

Tar Creek

- Greater than a 1 in 10,000 chance of an extra case of cancer from:
  - Using creek water for drinking and bathing.

All Watersheds

- More than 5% of children exposed to lead in these watersheds could have a blood lead level greater than 10 µg/dL (based on high-end exposure assumptions).

Aquatic Worker Risks

Elm Creek and Tar Creek

- Increased risk of noncancer health effects from work activities.
- A 1 in 10,000 chance of an extra case of cancer (Tar Creek only).
- More than 5% of fetuses could have blood lead levels greater than 5 µg/dL.

General Public Risks

Elm Creek and Tar Creek

- Increased risk of noncancer health effects:
  - Using creek water for drinking and bathing.
- Greater than a 1 in 10,000 chance of an extra case of cancer:
  - Using creek water for drinking and bathing (Tar Creek only).
- More than 5% of children exposed to lead in these watersheds could have a blood lead level greater than 10 µg /dL.

Elm Creek, Tar Creek, Beaver Creek and Lower Spring River

- More than 5% of children exposed to lead in these watersheds could have a blood lead level greater than 5 µg/dL.