ATSDR

Public Health Assessment

Caney Residential Yards
Caney, Montgomery County, Kansas

Public Comment Release

May 14, 2026

Public Comment Period Ends

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U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

The ATSDR Public Health Assessment: A Note Of Explanation

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's fulfilment of statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame based on currently available information. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time. This document has now been released for a 45-day public comment period. After the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued as a final document.

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PUBLIC HEALTH ASSESSMENT

Caney residential Yards

Caney, Mongtomery County, Kansas

EPA FACILITY ID: KSN000703396

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry (ATSDR)
Office of Community Health Hazard Assessment

Atlanta, GA 30333

About ATSDR

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency of the U.S. Department of Health and Human Services (HHS). ATSDR works with other agencies and tribal, state, and local governments to study possible health risks in communities where people could come in contact with dangerous chemicals. For more information about ATSDR, visit the ATSDR website at www.atsdr.cdc.gov/.

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1. Summary

Introduction

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency of the U.S. Department of Health and Human Services (HHS). As required by legislative regulations, ATSDR performs a public health assessment (PHA) of sites added to the National Priorities List (NPL). State agencies and the Environmental Protection Agency (EPA) provided the data used to conduct this PHA. The EPA added the Caney Residential Yards Superfund site, located in Caney, Kansas and partly in southwestern Montgomery County, Kansas, to the NPL on September 1, 2020. EPA finalized the interim Record of Decision on September 26, 2022. Historically, two smelters were located and operated in Caney, Kansas in the early 1900s. The American Zinc, Lead and Smelting (AZLS) Company's smelter started operations in Caney in 1904 at the site of the current high school building. The Owens Zinc Company's smelter operations began in 1915. Two separate brick manufacturing plants operated during the same timeframe as the smelter operations. This smelting activity in Caney ended in 1931. Smelter deposition and manual relocation of waste (e.g., to use as backfill, driveways, sidewalks, etc.) resulted in lead contamination on properties within the city of Caney. While other heavy metals (i.e., zinc, cadmium, and arsenic) have been detected adjacent to the old smelter locations, the primary contaminant of concern is lead.

Even though exposure from lead-based paint is the most common source of lead exposure, people who live within or near a lead-contaminated waste site are also at elevated risk of exposure. Other various risk factors are important to consider. For example, lead exposure during pregnancy may result in delays or impairment in cognitive development, low birth weight, decreased gestational age, growth retardation, and in girls, delayed sexual maturation. Lead contamination is especially concerning for children because they are more vulnerable to the adverse health effects from lead exposure than adults. They also play outside in their yards or around town in areas that may not have undergone remedial action. Efforts to remove lead-contaminated soil from residential yards are likely to reduce lead exposure.

Between 2015-2019, the EPA sampled 1056 residential properties for soil contamination with 345 qualifying for remediation of lead-contaminated soil greater than 400 milligrams per kilogram (mg/kg). Tables A1 through A3 summarize the properties that have had their soil tested for lead. Work is ongoing to ensure all properties receive the appropriate remediation.

As of May 2022, the EPA's Regional Screening Level remained 400 mg/kg. However, in 2024 the EPA decided to lower their site-specific soil screening values to 200 mg/kg for the Caney Residential Yards site. Updated calculations using Version 2 of the Integrated Exposure Uptake Biokinetic Model (IEUBK) informed this screening level (this change is detailed in EPA Region 7's current Interim Lead Policy). The decision for the change was also based on community and partner agency input, a

	public comment period and meeting, and consideration of other factors. After the change to the 200 mg/kg screening level, there are now about 740 properties that qualify to have their soil remediated.
Conclusions	The ATSDR has reached the following conclusions for Caney Residential Yards:
Conclusion #1	The ATSDR concludes that past, current, and possibly future contact with soil at properties around the site may harm people's health. Children are especially at greater risk for lead exposure from accidentally touching, eating, or breathing lead-contaminated yard soil.
Basis for Conclusion	Soil lead exposure The Centers for Disease Control and Prevention (CDC) has not identified a safe level of lead in blood and advises minimizing lead exposure when possible. Residents of all ages who live on remediated properties (with soil lead levels <200 mg/kg) are less likely to experience adverse health effects from lead exposure than properties with higher lead levels in soil. Remediation entails identifying yards that qualify for remediation (i.e., yards with soil lead levels that exceed 200 mg/kg), removing the contaminated soil, and replacing the contaminated soil with soil that does not exceed these lead screening levels. The entire remediation process ensures that exposure to these site-associated metals are reduced. The IEUBK Model for Lead in Children predicts that a soil lead level ≥200 mg/kg is likely to result in a peak average blood lead level (in children around 2 years old) of 3.0 µg/dL (Figure 4). IEUBK-Modeled Blood Lead Levels at Various Soil Lead Levels (100, 200, and 400 mg/kg).). Some homes may have soil lead above 200 mg/kg but have not yet received remediation. Three hundred forty-five properties with lead in soils above 400 mg/kg have been remediated and about an additional 630 properties with lead in soils above 200 mg/kg have been or will be remediated. This additional remedial action will further ensure reduced exposures to lead-contaminated soil throughout the community. Some locations with potential lead sources were not sampled (e.g., inaccessible locations). There may be areas in and around the town with unknown soil lead levels that may become places where children play. This is of particular concern as soil lead concentrations in some parts of the city reached as high as 28,500 mg/kg. Some properties adjacent to the smelting site also had other metals (i.e., arsenic and cadmium) at concentrations that might be harmful if exposed over years (Table A7). The only contaminant that was found at all three sites, and in all samples, was lead. Removal of any lead contaminated waste will also remove the other metals that may have impacted residential properties. Tables A1 through A3 in this document summarize the various sampling phases. Most of these properties have been remediated, or will likely be within the next year or two, further reducing risk of lead exposure to residents. Understanding exposure risks from contaminated soils,

especially for children, will help community members know when and how to take protective actions. For example, some children that are 2 years old may require caregivers to know when and how to protect themselves from exposure.

Recommendations for each property depend on remediation status. Sites that remain unsampled, or unsampled sites that are located on or near the historical smelter sites may have elevated levels of metals in the soil. Individuals should use caution when participating in activities on these soils. Some properties have soil lead levels below 200 mg/kg and do not require remedial efforts. There are properties that had soil lead levels above 200 mg/kg but have already had their property remediated. However, for properties that still have soil lead levels above 200 mg/kg, ATSDR recommends that the property owners complete remediation.

Soil cadmium exposure

Exposure to the highest estimated doses (i.e., highest levels of contaminants someone may come into contact with) of cadmium in children from birth to 6 years at properties A and B (these initial complaint sites, are highlighted below the Owens Zinc Site in Figure 2 may cause a small risk of harm to the kidneys. These properties also were included in the list of properties that were remediated due to average soil lead levels being > 200 mg/kg. Children with high exposure levels (Tables 9 and 10) may exceed the lowest effect level of 0.33 µg/kg/day for proteinuria (protein in the urine). Exposure in children 6 to 11 years old approaches the lowest effect level and presents some concern also. Individuals with diabetes may be more sensitive to the kidney toxicity of cadmium [ATSDR]. Smoking cigarettes or breathing cigarette smoke increases cadmium exposures, making smokers a sensitive population for potential health effects from cadmium [ATSDR].

Soil arsenic exposure

Exposure to the highest estimated doses of arsenic from soil in young children at property B may cause a small increased risk of cognitive decline (e.g., decreased IQ score) and newborn and infant health outcomes. The highest estimated arsenic exposure doses from properties A, B, and C were 0.14, 0.48, and 0.12 reasonable maximum exposure µg/kg/day, respectively, which is a concern for increased cancer risk. The estimated cancer risks from many years of exposure range from 1 to 14 excess cancer cases out of 10,000 people. Exposure to arsenic is associated with lung cancer, nonmelanoma skin cancers, and bladder cancer [EPA]. There is limited evidence for association with kidney, liver, and prostate cancers.

Next Steps

Community Members – ATSDR recommends that all community members take personal actions to minimize contact with lead from all sources. Contact ATSDR for fact sheets or further information.

Caney community members can reduce the amount of contact children have with cadmium by minimizing their exposure to secondhand cigarette

	smoke. Residents can reduce their potential exposure to metals in soil by the following: • Damp mop rather than sweep dust from the inside of homes and wipe down surfaces regularly with a damp cloth. • Remove dusty shoes and clothing before entering homes. • Regularly wash pets that spend time indoors and outdoors. • Wash hands before cooking or eating, and after outdoor recreational activities. • Encourage young children to frequently wash their hands, especially before eating. • Discourage young children from ingesting soil or eating food that has fallen on the ground. • Cover any bare yard soil with clean soil, rock, or a vegetative cover. • Wear a dust mask, gloves, and protective clothing when using arsenic-treated wood in home projects to reduce exposure to sawdust. • Shower and change clothes after work if your job may involve arsenic exposure (e.g., copper or lead smelting, wood treating, pesticide application, etc.) to avoid bringing it into your home. <u>EPA and Local Health Agency</u> – ATSDR recommends the EPA to continue their efforts in remediating contaminated soils throughout the community where people can become exposed, including public spaces like schools, childcare facilities, parks, and playgrounds. ATSDR recommends that the EPA or local health agency provide childcare facilities with educational materials on a semi-regular occasion (e.g., once a year, once every other year) so that lead awareness will continue to be a focus. ATSDR also recommends that these materials be readily available to the broader community to support residents in better understanding the importance of soil sampling and, when appropriate, soil remediation in residential yards. Continued community-wide public education about lead hazards can promote a culture of awareness and safety. Exposure to lead should be minimized as much as possible as there is no known safe level of lead in the blood.
Conclusion #2	ATSDR cannot conclude whether consuming local produce, fish, or well water or breathing outdoor or indoor air in Caney, KS could harm people's health. The data available are insufficient to evaluate these pathways directly.
Basis for Conclusion	Gardening and consuming produce grown in contaminated soil may increase exposure to the contaminants. There are no data showing whether or not contaminants are present in or on produce grown in Caney. Dust on the surface of the produce may contain site-related contaminants and may be a source of exposure. Also, fish caught in the

local ponds and streams may be a source of exposure if the fish contain elevated levels of site-related contaminants.

Outdoor air is considered to be a potential pathway of exposure. However, screening of historical site-related contaminant levels in the outdoor air is not possible because there are no outdoor air data available. There are also no indoor air data available for lead and other metals. Sources of metals other than outdoor air may contribute to indoor air contamination by the release of metal-containing dust, especially from deteriorating leaded paint.

The migration of contaminants from soil dust is considered a potential exposure pathway. However, now that most properties have been remediated, the risk of such an intrusion is less likely to occur. Community members should be aware that fugitive dust may have impacted the dust in their attic and may benefit from taking extra precautions to ensure that dust from this location is not disturbed.

Exposure to site-related contaminants from drinking and household water use in Caney is not considered a exposure pathway. All residences east of the Little Caney River to Coffeyville and north to at least Havana receive their water from the Caney public water supply (surface water from the Little Caney River, within a 4-mile radius) or the Montgomery County Rural Water District #5 (surface water from the Verdigris River outside a 4-mile radius) which regularly tests and treats the water to minimize exposures to contaminants, including lead. Also, surface water runoff at the original smelter site has been reported to flow mainly to the West. Lead levels in surface water were measured during the preliminary assessment in 1991 at 0.011 mg/L, which is slightly above the EPA's drinking water rule (i.e., Lead and Copper Rule) of 0.010 mg/L. The most recent water quality report (Table 3) suggests that contaminant migration is not impacting the community's drinking water supply.

Next Steps

Community Members – ATSDR recommends that all community members take personal actions to minimize contact with lead and other site-related contaminants, this includes thoroughly washing local produce with a brush and peeling root vegetables before eating.

A blood test is the most reliable way to determine a child's exposure to lead, especially after sporadic exposures, as lead has a half-life of about one month in the bloodstream [ATSDR]. Many children with lead in their system do not exhibit obvious symptoms. The CDC recommends blood lead testing for children enrolled in Medicaid at ages 12 and 24 months, or ages 24-72 months if they have never been screened as well as for children not enrolled in Medicaid with known exposure to lead sources. If a child's venous blood lead level is ≥ 3.5 µg/dL, CDC recommends healthcare providers perform the following: conduct a detailed exposure history, evaluate the child's diet focusing on calcium and iron intake, check for iron deficiency, monitor the child's developmental milestones, and refer caregivers to supportive services as needed. If blood lead levels reach 20

	µg/dL, CDC recommends further testing within two weeks to one month, along with environmental investigations to identify and mitigate lead sources [CDC]. EPA and Local Health Agency – ATSDR recommends that EPA continue their efforts in remediating contaminated soils throughout the community where people can become exposed, including public spaces like community gardens, schools, childcare facilities, parks, and playgrounds. ATSDR recommends the local health agency to provide resources to residents (e.g., factsheets) and community-wide public education about lead hazards can stimulate a general culture of awareness and safety and reduce the risk of exposure. Taking time to observe and/or commemorate the various milestones and successes within the community may promote ongoing engagement and reinforce shared progress
For More Information	ATSDR contact information: Copies of this report will be provided to concerned residents in the vicinity of the site via the city offices, city library, and the internet. ATSDR will notify area residents that this report is available and provide a copy upon request. Questions about this public health assessment should be directed to the ATSDR by calling the CDC-INFO line at 800-CDC-INFO (800-232-4636) or TTY 888-232-6348.

2. Background

2.1. Statement of Issue and Purpose

Historic smelter-related mining activities resulted in cadmium, lead, arsenic, and zinc contamination in surface soils throughout the town of Caney, Kansas (Figure 1. Map of Caney, Kansas place equivalent and township area. Most wide-spread contamination is due to the movement of smelting waste from previously active sites by residents for use in and around their yards, driveways, and for backfill in general.

From 2015-2019, the EPA conducted sampling on 1056 residential properties and cleaned up more than 300 of these properties due to contamination levels above the screening level. The site has been on the NPL since September 2020.

ATSDR Region 7 prepared this public health assessment. This assessment uses available environmental data collected at properties throughout the town to evaluate community exposures and makes recommendations to prevent exposures to hazardous substances in the environment at levels approaching or exceeding those known to increase risk of adverse health effects.

2.2. Site Description and Timeline

The Caney Residential Yards Site (EPA ID: KSN000703396) was added to the NPL due to historic smelting operations dating back a century which caused lead contamination of numerous residential yards. People who worked at these smelters also brought material (e.g., cinders) home for use as backfill, driveway paving, and landscape material [EPA]. These activities lead to the contamination of numerous residential yards. The levels and extent of contamination are documented by both the EPA and the Kansas Department of Health and Environment [KDHE; EPA; EPA].

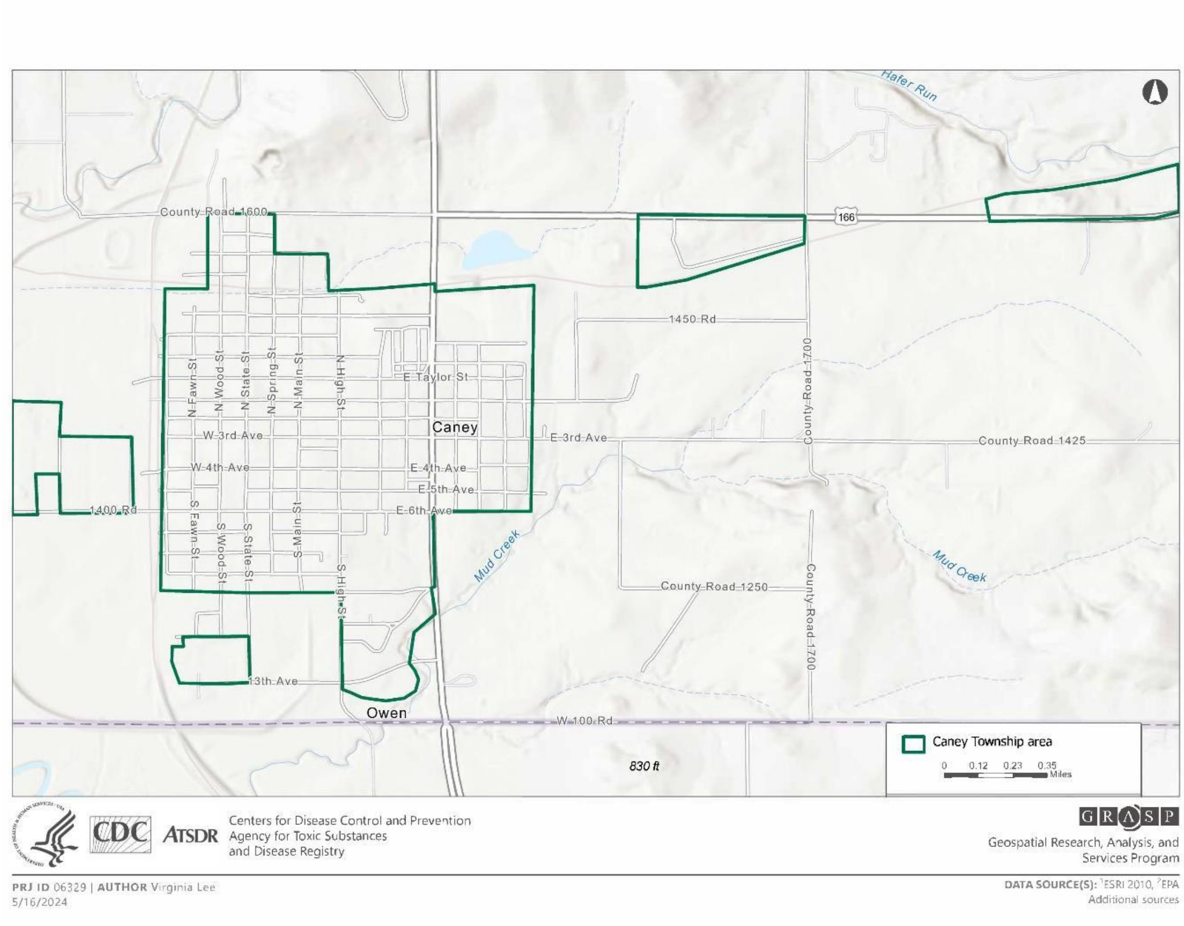

Figure 1. Map of Caney, Kansas place equivalent and township area.

Smelting processes in Caney coincided with brick manufacturing with operations starting in the early 1900s until 1931. The first appearance of the Caney Zinc Company [Sanborn] on the Sanborn maps shows that the company occupied the same property space which soon became AZLS. Sanborn maps were created for cities and towns throughout the United States during the 19th and 20th centuries for the Sanborn Map Company out of Pehlham, New York for fire insurance purposes. They are now available as part of the public record.

The 1912 Sanborn map for Caney shows the locations of both AZLS and The Caney Brick Company [Sanborn]. The Caney Brick Company plant was located about a half mile northwest of the AZLS site and operated from 1902 to 1915 (Figure 2). A smelting plant was built over this location to construct the Owens Zinc Smelter Works facility in 1915 which had one ore roaster and three furnace buildings. It was in full operation until 1918 when it was sold to the Weir Smelting Company. The Weir Smelting Company purchased the land containing the facility in 1927 and continued operations until 1931.

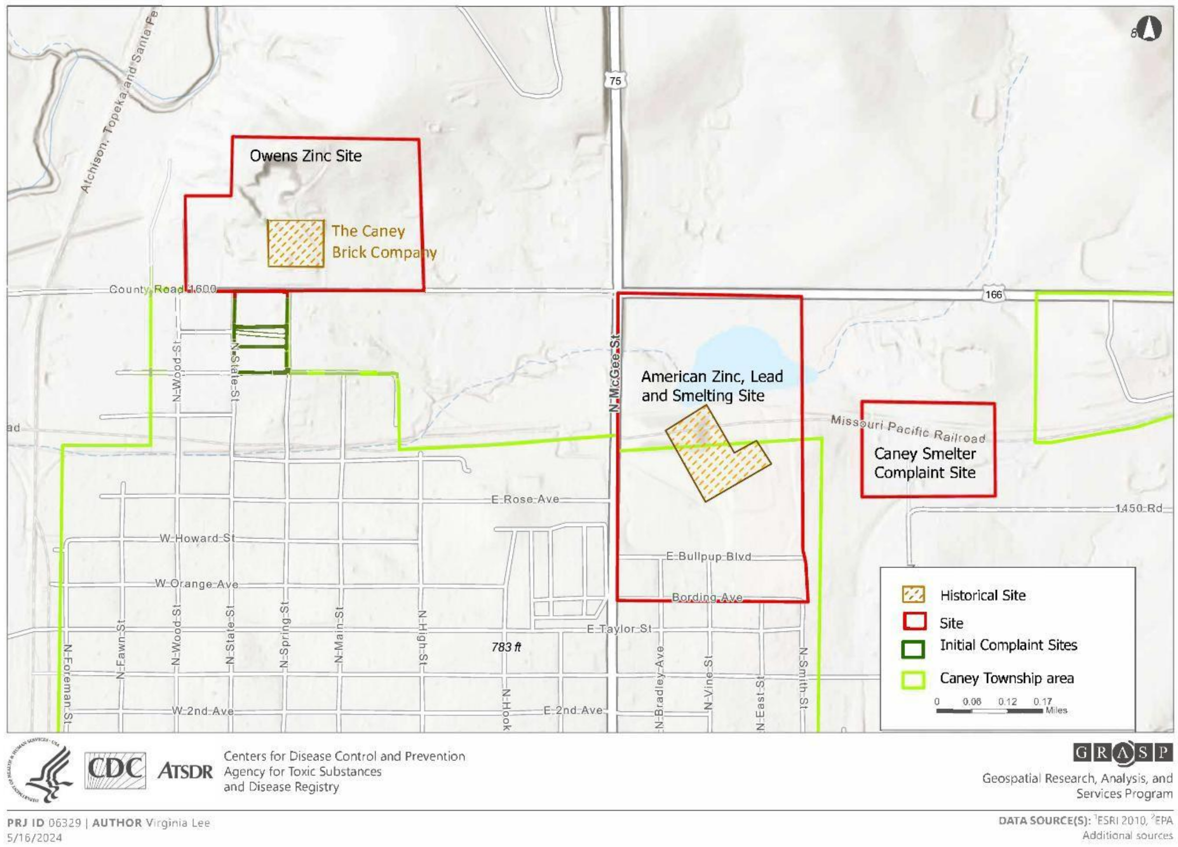

Figure 2. View of Caney with historical smelting sites and some sampled properties highlighted [KDHE]. The locations of the outlined Historical Sites are approximate locations identified in a 1912 Sanborn map [Sanborn].

During cleanup, sites are often divided into several distinct areas to address specific problems. Before city-wide clean-up efforts were considered, off-site contaminants were suspected to be present on separate properties adjacent to the historical sites where the wastes were largely generated. These three sites included: the Owens Zinc Smelter site located just north of the impacted residential yards (EPA identification number KSD984971911); the AZLS site, which is also the central-most site (EPA identification number KSD984971986); and the Caney Smelter Complaint site (EPA identification number KSN000706287), located east of the AZLS site (Figure 2).

Field investigations confirmed that historic smelter deposition and manual relocation of waste (e.g., to use as backfill, driveways, sidewalks, etc.) resulted in contaminated properties within the city of Caney. As part of a cooperative agreement with the EPA, the KDHE conducted various assessments to verify the presence of hazardous contaminants at the Caney Residential Yards site. These investigations were performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR § 300. KDHE completed the Preliminary Assessment in 1990, the Site Inspection in 1992, and the Removal Assessment in 1993. A potentially responsible party (PRP) for removal action was identified in 2000. KDHE's Expanded Site Inspection [KDHE] for the Owens Zinc Site (Figure 2) indicated the presence of the Resource Conservation and Recovery Act (RCRA) contaminants, specifically the metals lead (maximum levels measured = 4,845 mg/kg soil), cadmium (maximum measured = 1,099 mg/kg soil), and zinc (maximum measured = 32,210 mg/kg soil). Measures in surface water reached levels as high as 1.15 mg/L for cadmium, 0.011 mg/L for lead, and 22.8 mg/L for zinc [KDHE].

In 2004, a consent agreement with a PRP, Blue Tee Corporation, helped initiate the work that led to the eventual on-site consolidation and capping of the contaminated wastes at the Owens Zinc Site. Due to various considerations, including community concerns, KDHE requested that the PRP conduct additional off-site work. These off-site investigations were conducted between 2012 and 2015 to determine what properties may have soil lead levels that exceed EPA screening levels. The State of Kansas petitioned the EPA for time-critical removal action in early-2015 [KDHE]. The EPA approved the creation of the Caney Residential Yards Superfund site, as identified by CERCLA ID KSN000703396.

A total of 992 properties had soil sampling conducted between 2015 and 2018 (Table A1). Between May 2015 and December 2015, EPA visited 529 properties, 279 granted access to allow for environmental sampling, 86 were vacant, 125 had no answer or refused to answer, and 39 property owners denied access [EPA]. Between August 2016 through September 2018, activities led by the EPA garnered access to 713 more residential properties, including properties that were not previously accessible [EPA].

The EPA then led efforts from September 2019 through October 2019 to further identify any other sites or areas of concern and to sample for lead contamination at sites that were not addressed in previous remedial and removal efforts (e.g., residential properties, alleys, and rail lines) [EPA]. The EPA continues to work on the Caney Residential Yards site, and due to recent screening level changes for this site, properties that did not meet the criteria previously, may now qualify to have their property remediated.

3. Community Description and Concerns

3.1. Community Demographics

Caney, Kansas is located along the state's southern border in the southwest corner of Montgomery County with a land area of about 1.4 square miles. According to the 2020 U.S. Census 1,788 people reside in Caney; this was about a 19% decrease compared to the 2010 U.S. Census. There has been an overall downward trend in local population since the highest reported population of 3,597 in 1910. Census data show that populations for Caney Township increased 113% between 1890 (1,967 people) to 1900 (2,235 people) and again grew 161% between 1900 to 1910 [Census; Census]. This upward trend at the turn of the 20th century was likely due to the economic opportunities offered by the then-active smelting operations in and around Caney.

According to the U.S. Census Bureau's 2023 estimation for the population in Caney (Table 1), there are about 120 children under 5 years, 322 children aged 5-14, 95 youth aged 15-17, and 913 adults aged 18 years or older [Census]. They also report on about 820 total households, with a median household income of $40,000. About 80% of the population identifies as "White alone" with the next largest population, 5%, identifying as American Indian or Alaska Native alone. English is the predominant language spoken by about 96% of the population, followed by Spanish (2.7%), Asian and Pacific Islander languages (1.3%), and then other Indo-European languages (0.4%). Based on the 2020 American Community Survey, there are slightly more females than males in Caney (about 94 males to 100 females). With a conservative estimate of 50% population representation for each sex, the survey would reflect that there are about 313 women of childbearing age (considered ages 15-44) who reside here. This is important because lead, the primary contaminant associated with this site, can cause serious health effects in young children before and after birth. There are at least 82 children younger than six years old. Other demographics are listed in Table 1. Also, about 84% of the houses in this community are pre-1980s units [Census]. Most homes built before 1980 have historically had leaded paint applied in the interior of the home which may still be a source of leaded dust in the home.

Table 1. A summary of population by age and sex for all of Caney from the 2023 Census American Community Survey 5-year estimates [Census].

	Population	Male	Female
Total population	1450	40%	60%
Under 5 years old	120	22%	78%
5-14 years old	322	52%	48%
15 to 17 years old	95	64%	36%
Under 18 years old	537	48%	52%
18 years and older	913	35%	65%

There are many children that live and play in and around the town. Importantly, children are at greater risk to the adverse health effects from lead exposure. While the most common source of lead exposure in the nation is from lead-based paint dust, people who live within or near a lead-contaminated waste site are also at elevated risk of exposure. Lead exposure during pregnancy may result in delays or impairment in cognitive development, low birth weight, decreased gestational age, inhibited growth, and delayed sexual maturation in girls.

The State of Kansas reports only a couple of licensed childcare facilities in Caney. However, according to various websites (i.e., childcarecenter.us; facebook.com) various other childcare facilities were identified. Childcare facilities located close to the sites of concern could be impacted by the translocation of mine waste. At the time of the writing of this report, EPA has initiated investigation to determine if these facilities have been impacted.

Caney Valley High School is located within the Caney Township boundary and may be impacted by the American Zinc Lead and Smelting Site (Figure 1). Though not initially part of the Record of Decision, recent agreements with the PRP will ensure that the school grounds receive appropriate soil testing and remediation as necessary to reduce or prevent future exposures.

Blood lead level (BLL) is a measure of how much lead is in the blood. The CDC's Blood Lead Reference Value (BLRV) was created in order to identify children who have higher levels of lead in their blood when compared to the large majority (97.5th percentile) of other children in the U.S. The BLRV changed in 2021 from 5.0 µg/dL to 3.5 µg/dL, in whole blood. This new reference value places an emphasis on primary prevention; controlling or eliminating sources of lead in children's environments so that their exposures are reduced; and triggering targeted public health actions to lower blood lead levels. This level is based on the highest 2.5% of children ages 1-5 years in the U.S. population using the 2015-2018 National Health and Nutrition Examination Survey (NHANES). The NHANES is a population-based survey used to assess the health and nutritional status of adults and children in the country.

KDHE reports that in 2019 (the most recent data made available to ATSDR) about 4.5% of the children <6 years old in Montgomery County tested had a BLL above 5 µg/dL. Importantly, only about 12% of the total number of children or 267 children were tested [KDHE]. This means that nearly 9 out of 10 children have unknown BLLs suggesting that some children may be living with elevated lead in their blood.

4. Sampling Data

All data sources were provided by the EPA and KDHE. The Integrated Assessment report by KDHE [KDHE] provides the earliest data on soil lead levels in proximity to the old smelting sites. The EPA then sampled the soil of all properties identified in the 2015 report where consent was given and remediated the qualified properties [EPA].

2012-2013 Sampling at Three Residential Properties

Due to citizen complaints, KDHE conducted some initial residential soil sampling activities from June 2012-July 2013 at three properties that were adjacent to the original smelter site (Figure 2). Sampling confirmed that soil lead levels exceeded 400 mg/kg in various locations. This level was twice that of the 2024 updated regional screening level of 200 mg/kg. Samples were analyzed in the field via XRF, consistent with EPA Method 6200. For all properties, about 45% of all samples were submitted for confirmatory analysis following EPA Method 6010.

All samples were collected from discrete locations following the guidelines outlined in the USEPA August 2003 OSWER 9285.7-50 Final Superfund Lead-Contaminated Residential Sites Handbook [EPA]. Briefly, the property was divided into areas (e.g., ≈ ¼ acre quadrants, if the property is large enough) and samples were collected from the front, sides, and back yards of each property. Sample aliquots were collected using a two-inch diameter, stainless steel hand auger, or small remote-controlled Geoprobe.

The surface samples in this collection effort consisted of the top 6 inches of soil. ATSDR considers a depth of 0 to ≤ 3 inches of subsurface soil to be more representative of exposure point concentrations. Deeper soil levels might result in a sample that is less representative of exposure. For example, if deeper soil has lower lead levels, it might dilute the reported level of the metal and underestimate calculated exposure point concentrations.

The levels of arsenic and cadmium on these properties did not reach the higher levels found at the old smelter site (offsite) and nearly half of all samples had levels too low to be detected. Nearly 60% of all samples had lead levels above 200 µg/kg. The only contaminant that was found at all three sites, and in all samples, was lead. This suggests that removal of any lead contaminated waste will also remove the other metals that may have impacted other residential properties. A summary (e.g., means, medians, highest reported, etc.) of these pre-remediation sampling data (as found in the appendices in the Integrated Assessment Report [KDHE]) is captured in Table 5.

2015 Removal Assessment Sampling

The EPA then started work throughout the City of Caney (i.e., the Caney Residential Yards NPL site) from May 26 to December 4, 2015 (Table A1) for the removal assessment screening process for the Caney Residential Yards Site [EPA]. Sample locations during this sampling period were largely located in the northern half of Caney (Figure 2). Sampling was done following the guidelines outlined in the Superfund Lead-Contaminated Residential Sites Handbook [EPA]. Briefly, sampling was done by collecting composite surface soil samples. Each property was divided into cells which included drip zones, road easements, fine-grained material used for driveways, sidewalks (exposed soil along brick sidewalks), under carports, vegetable gardens, and children's play areas by at least 25' by 25', with sizes and shapes largely depending on the size and shape of each yard.

A composite sample consisting of nine aliquots, each from the top 2 inches of soil, was collected by hand trowel and labeled in a sealed plastic bag. After transporting samples to the processing facility, each sample was transferred to a clean dedicated tray and allowed to air dry. Samples were then passed through a #10 (2 mm) stainless steel sieve to obtain the smaller size fraction. Samples were not forced through the sieve which would change the physical structure of the samples and bias the results.

Subsurface soil sampling was performed at nine residences, during pre-remediation activities, using a Geoprobe® Manual Slide Hammer. For all subsurface sampling locations, samples were collected at 12-inch depth intervals (0-12 inches and 12-24 inches) with each subsurface sample undergoing the same process as the surface samples after retrieval.

During this effort, the EPA visited 529 properties. Out of these, 279 property owners granted access to have their property sampled. Of all property samples (Table A1), 136 had all soil samples with lead content below 400 mg/kg, 73 properties had at least one sample with lead content above 400 mg/kg , and 70 properties had at least one sample with lead content above 400 mg/kg in the drip zone or road easement only [EPA]. All homes that tested above the screening level for lead were tested using XRF (Table A6). Subsurface soil sampling was also conducted at nine residential properties indicating that most of the lead contamination rests within the top 12 inches of soil (Table A4).

2016-2018 Removal Assessment Sampling

The EPA then widened the scope of the sampling area to include the rest of Caney (Figure 3) and some of the properties visited in 2015 where access had not been initially obtained. Soil sampling was conducted from August 8, 2016 to September 4, 2018. Sample collection and analysis procedures for surface soil were similar to those outlined above during the 2015 collection activities. This procedure differed slightly from EPA Region 7 Standard Operating Procedure (SOP) 4230.19, which specifies collection of samples from the top 1 inch of soil. To get below the root zone, it was decided to collect from the top 2 inches of soil instead of just 1 inch [EPA]. This approach more closely aligns with ATSDR's preference to collect from a depth of 0 to ≤ 3 inches.

During this period (2016-2018) the EPA visited 713 properties. Of all properties sampled for lead (Table A2), 338 had all soil sampled areas with lead content below 400 mg/kg, 248 had at least one sample with lead content above 400 mg/kg, and 127 properties had lead concentrations exceeding 400 mg/kg in the drip zone only. To ensure accurate XRF measurements, approximately 10% of all samples were selected to be sent to a certified laboratory for confirmatory metals analysis [EPA]. The samples sent were selected from wide ranging XRF-reported lead concentrations (17 to 2,387 mg/kg). The results reported by the laboratory were compared to the XRF measurements via linear regression (i.e., via least squares linear regression as outlined in Section 9.7 of EPA's Method 6200 [EPA]). An r^2 value equal to or greater than 0.7 means that the XRF reported values are acceptable to use for screening. An r^2 value of 0.8709 was calculated for the XRF unit used during this assessment [EPA]. Soil sampling methods followed the approved site-specific Quality Assurance Project Plan (QAPP) and generally followed guidelines established in the Superfund Lead-Contaminated Residential Sites Handbook [EPA].

2019 Removal Assessment Sampling

From September 30 to October 23, 2019 more field activities were conducted that were focused on sampling and screening surface soils for lead (including assessing bioaccessibility), cadmium, and zinc, at residences, abandoned rail lines, city properties, and alleys near the former smelters. The EPA visited 86 residences and also attempted to obtain permission from the City and various tribal partners. Of these 86 visited, access was granted to 36 residential properties (Table A3). Samples were also taken from 28 other properties through town that were nonresidential properties (i.e., alleyways, various city-owned properties, and smelter waste within streets and sidewalks). Out of 64 sampled properties, 39 had all soil sampled areas with lead content below 400 mg/kg, 24 had at least one sample with lead content above 400 mg/kg, and 1 had at least one sample with lead content above 400 mg/kg in drip zone or road easement only. The bioaccessibility analyses showed an average of about 64% bioaccessibility (n = 36;

ranging 54.1% - 86.7%; Table A5) [EPA]. Soil sampling and quality control methods followed the same sample procedures as those during the 2016-2018 sampling event.

5. Scientific Evaluations

A health-based comparison value (CV) is a predetermined concentration of a substance in air, water, or soil that is highly unlikely to cause adverse health effects; it is used as a screening tool to identify contaminants of concern. There are no CVs for lead exposure as there is no known safe level of lead in the body. ATSDR CVs for arsenic, cadmium, and zinc are 3.1 mg/kg, 5.2 mg/kg, and 16,000 mg/kg, respectively. For the 2012-2013 study, each of these three metals exceeded the CV in at least one sample. Due to these exceedances, further evaluations were performed and included hazard quotient and cancer risk calculations. A hazard quotient is a ratio of the site dose to the ATSDR minimal risk level (MRL) and indicates further toxicological evaluation is needed when the hazard quotient is greater than one. Exposure doses less than MRLs are not considered a hazard, whereas exposure doses greater than MRLs require further evaluation. Calculating possible blood lead levels for various ages, depending on soil lead concentrations, was also performed.

The EPA's residential screening levels are largely based on the CDC's previous BLRV of 5 µg/dL. The previous/historic higher soil screening level of 400 mg/kg lead was considered generally reasonable for screening residential soil in the past when the nation's upper average blood lead levels were higher (i.e., 10 µg/dL). The recent change to a soil screening level of 200 mg/kg lead more closely aligns with the model-validated BLL value of 5 µg/dL and a screening level of 100 mg/kg lead more closely aligns with the CDC's BLRV of 3.5 µg/dL and childhood assumed ingestion of contaminated soil. The EPA is currently using a regional soil screening level of 200 mg/kg lead as their clean up level for soil lead-contaminated residential sites [EPA]. These screening levels assist in identifying what locations are likely to result in the most exposure to site-related contamination.

Exposure pathways are the link between a contaminant source and a person; it defines how individuals may come into contact with hazardous substances. A review of exposure pathways considers 1) the source of the contaminant, 2) the fate and transport of the contaminant through environmental media like air, soil, sediment, and water, 3) exposure points where people can come into contact with the contaminant, 4) an exposure route in which it can be taken into the body, and 5) an exposed human population.

Completed exposure pathways include all five of the above elements. If one or more components of a pathway are missing or exposure has been stopped, the pathway is incomplete and exposure does not occur. Potential exposure pathways are usually due to some elements that are not defined clearly. Even though an exposure pathway may be complete, that does not mean that there will be adverse outcomes. Development of health outcomes depends on various factors, such as the toxicity of a chemical or how long and how much a person is exposed to. Further evaluation of the specific exposure scenario is often needed to determine whether the exposure could increase risk of adverse health effects.

Table 2. explores the various exposure pathway elements relevant to people who live in Caney, Kansas (in the past, now, or in the future). Potentially completed exposure pathways are further discussed in the screening analysis sections below. These evaluations provide details that describe how these exposures may occur and how to limit or prevent them.

Table 2. Exposure pathway analysis showing the various pathways, sources, environmental mediums, exposure points, and routes of exposure to lead.

Pathway	Source	Environmental Medium	Point of Exposure	Potentially Exposed Population	Route of Exposure*	Pathway completion
Soil	Residential soil	Soil	Residential	All who may come into contact with the soil	Ingestion	Potential†
Food Chain	Food grown in or near exposed contaminated soil	Food	Residential	All residents who garden, grow produce, and/or consume produce locally grown. Consumption of fish from local ponds and streams	Ingestion	Potential#
Groundwater	Well water	Water	Residential	Residents	Ingestion	Potential*
Surface water	No known surface water drinking sources within City	Water	None	None	None	Incomplete
Drinking Water	Public Water Supply	Water	Residential	All residents, employees, or visitors	Ingestion	Incomplete
Ambient Air	Windblown Dust	Air	Residential	All residents, employees, or visitors	Ingestion, inhalation	Potential

† "Potential" due to the possibility that an individual, especially a child, may become exposed to hazardous levels of lead in an area that has not been remediated.

"Potential" due to the possibility that an individual might eat a fish that was obtained adjacent to contaminated waste.

* "Potential" due to the possibility that an unknown or unregistered well may exist, may have been used in the past, or may possibly be used in the future. The Kansas Geological Survey does not identify any functioning water wells within city limits. Four wells (each well is > 40 years old) exist about half a mile north of city limits, and one new well (registered in 2024) exists about 1 mile north of city limits [KGS]. Fifteen domestic wells were found between 1 and 4 miles from the site. There are no public water supply wells within the 4-mile radius.

5.1. Household Water Evaluation

5.1.1. Screening Analysis

Table 3 summarizes lead testing results provided by the City of Caney [KDHE]. The City of Caney operates their public water supply, as required by federal law, which requires strict water quality standards and reporting. The City of Caney provides their water quality report annually as published by the authority of KDHE. Levels of contaminants, such as lead, are within the standard limits [EPA]. ATSDR does not have drinking or shower/household water use CVs for screening lead.

Table 3. A snapshot of the Consumer Water Quality Report - 2023, covering year - 2022 for lead. Water quality reports are provided by the City of Caney [Caney].

Regulated Contaminant	Monitoring Period	90^{th} Percentile	Range Measured	Units	Action Limit

Lead	2020-2022	3	0-3.4	parts per billion (ppb)	10

5.1.2. Evaluation of Drinking Water

The community receives their water from a public water supply, which controls for lead and other contaminants regulated by the EPA. The water utility pulls water from the Little Caney River and releases their water quality report for anyone to access. Also, no domestic or public water supply wells were found within one mile of the smelting sites. The City of Caney is on a public water drinking supply and exposure to lead from the public drinking water supply was not observed to exceed the action limit (Table 3).

5.1.3. Evaluation of Well Water

Fifteen domestic wells were found between 1 and 4 miles from the smelting sites. There are no public water supply wells within the 4-mile radius. There is a possibility that an unknown or unregistered well may exist, may have been used in the past, or may possibly be used in the future. The Kansas Geological Survey does not identify any functioning water wells within city limits, with four wells (each well is > 40 years old) identified about half a mile north of city limits, and one new well (registered in 2024) about 1 mile north of city limits [KGS 2025]. ATSDR did not identify any private well water sampling data to evaluate.

5.2. Soil Evaluations

5.2.1. Soil Screening

Table A1, Table A2, and Table A3 summarize the properties that have had their soil tested for lead. Out of about 1,050 residential properties in the City of Caney, the EPA has sampled the majority of them for soil contamination with residences qualifying for remediation of lead-contaminated soil greater than 400 mg/kg. As of May 2024, the EPA's soil lead screening level has changed, nationwide, to 200 mg/kg [EPA]. This change occurred soon after the Caney Residential Yard's EPA team decided to lower their site-specific soil lead screening values to 200 mg/kg [EPA]. Updated calculations using Version 2 of the Integrated Exposure Uptake Biokinetic Model informed this screening level [EPA]. The decision for the change was also based on community and partner agency input, a public comment period and meeting, and consideration of other factors. Importantly, these new screening values are also not health-based screening values, but based on the level at which a child has more lead in their blood than do 97.5% of U.S. children aged 1-5 years old [CDC] and the range in which the EPA model is validated (down to 5 µg/dL). Properties where screening levels were exceeded only in drip zones and road easements did not qualify for remediation. With the changing soil lead screening level (to 200 mg/kg), the estimated number of residences in Caney qualifying for remediation increases to about 740.

Figure 3 is a map showing the properties and parcels identified for sampling and includes status of cleanup [EPA]. At the time this figure was created, of the 1,041 residential properties sampled, 345 were remediated due to lead soil contamination greater than 400 mg/kg. Concentrations of lead in some parts of the city reached upwards of 33,400 mg/kg. Approximately 32 residential properties had not been sampled for lead contamination at the time this report was published [EPA]. Even remediated properties may have some lead in soil presenting a completed exposure pathway.

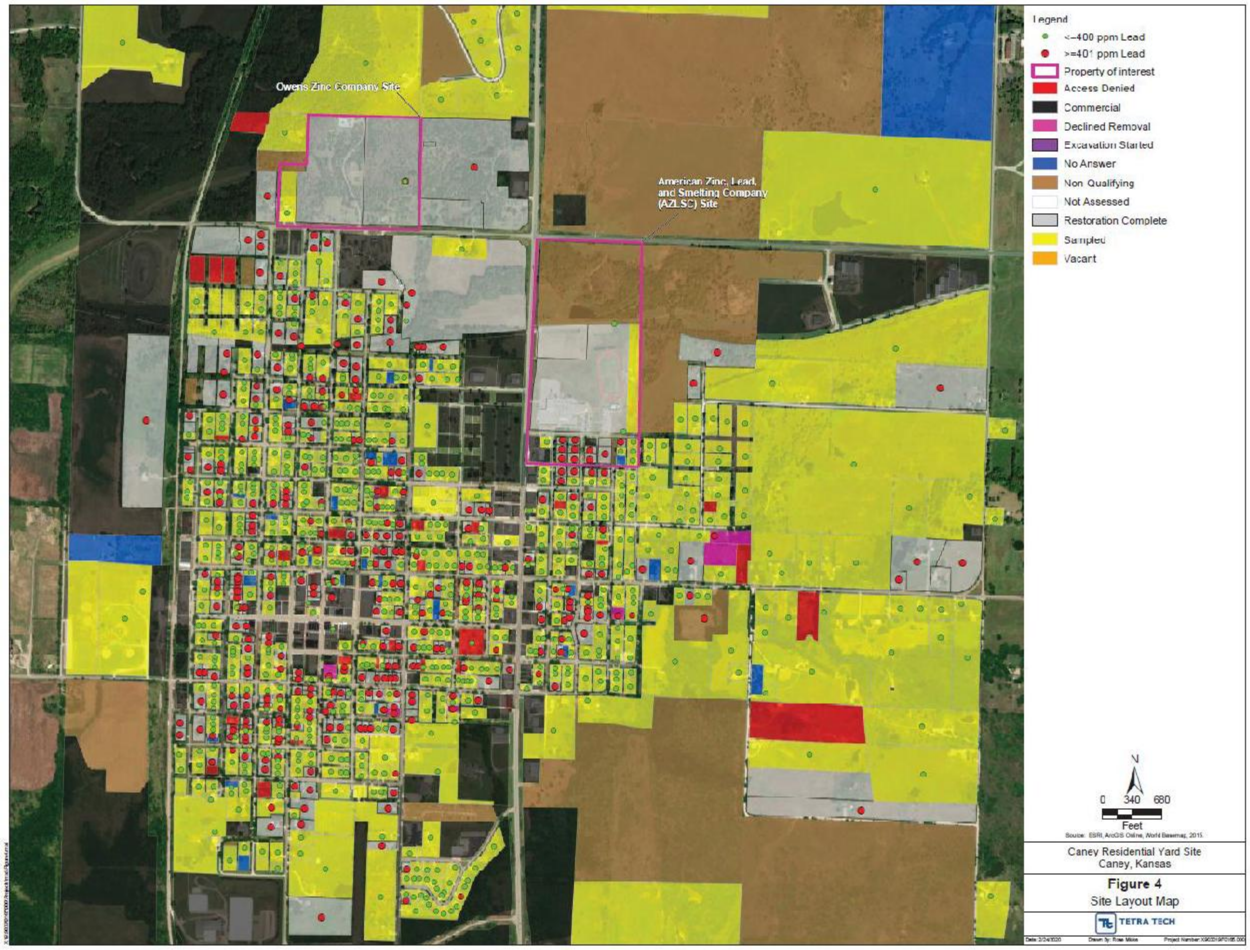

Figure 3. Caney Residential Yard site map showing areas that have been restored, in the process of being restored, have been sampled but are below 400 mg/kg soil lead levels, and other key features [EPA 2020].

Not all homes received remediation even though they may have soil lead levels above 200 mg/kg, and it is possible that some locations were overlooked leading to other unknown sources of lead in the community. For example, the screening data, in general, indicated that subsurface lead levels were lower than the surface levels. However, one subsurface sample was higher than the surface. It is unknown what caused this, but this demonstrates that lead exposure may be an important health and safety consideration for people who are digging into areas that may be contaminated.

5.2.2. Evaluation and Health Discussion of Soil Exposure

ATSDR's public health assessment process is to estimate how much exposure to contaminants occurs and to evaluate the potential for health effects from the exposure.

Calculation of Exposure Point Concentrations, Hazard Quotients, and Cancer Risk Estimates

ATSDR used KDHE and EPA data [2015 data: KDHE; 2014 data: EPA; and the 2019 data: EPA] to calculate exposure risks. These data were then used to generate Exposure Point Concentrations (EPCs) using ATSDR's EPC tool. After generating an EPC for each location and contaminant, ATSDR's Public Health Assessment Site Tool (PHAST) was then used to estimate exposure from residential scenarios as well as calculate hazard quotients (HQs) and cancer risks. Some children intentionally eat soil, which is called soil-pica. Importantly, ATSDR assumes soil-pica is occurring in any scenario where children could be exposed to contaminated soils. Because of this, soil-pica CVs, were derived from corresponding oral

MRLs for pica exposure scenarios using conservative assumptions (e.g., intake rate, exposure frequency, and body weight) for children [ATSDR]. Table 5 provides a summary of all the calculated EPCs, HQs, and cancer risks. Briefly, arsenic and cadmium were found at levels that resulted in chronic HQs ranging from 0.81 to 9.4 and cancer risk calculations for arsenic ranging from 1 to 14 excess cancer cases out of 10,000 people. Soil pica HQs ranged from 0.21 to 17. A breakdown of these calculations can be found in Table A7. The data that were used to generate these statistics were taken from discrete samples obtained at each of the three different properties (i.e., Properties A through C). These samples were taken from an area adjacent to the AZLS company's original operation site and do not necessarily represent soil metal levels throughout the community.

Table 5. Various property and community soil concentration data are presented with data summaries (highest reported, mean, median) and their associated Exposure Point Concentrations, maximum Noncancer Hazard Quotients, and maximum calculated cancer risks.

Metal	# of Samples	Highest Reported (mg/kg)	Mean (mg/kg)	Median (mg/kg)	EPC (mg/kg)	Selected EPC	Chronic HQ (CTE; RME)	Pica HQ	Cancer Risk (CTE; RME)
Property A As	36	24	5.4	0.05	10.7	95% UCL	1.1; 2.3	0.24	1.5e-4; 4.1e-4
Property A Cd	15	93	29.5	27	44.7	95% UCL*	4.2; 9.4	17**	NA
Property A Pb	36	5100	468.3	299	735	Average	NA	NA	NA
Property B As	22	176	21.0	8.8	36.9	95% UCL	3.7; 7.9	0.84	5.1e-4; 1.4e-3
Property B Cd	11	27	16	16	25.2	95% UCL	2.4; 5.3	9.6**	NA
Property B Pb	22	529	218	170	275	Average	NA	NA	NA
Property C As	6	9.4	4.3	3.7	9.4	Maximum	0.88; 2.0	0.21	1.3e-4; 3.6e-4
Property C Cd	3	9.1	8.1	7.8	9.1	Maximum	0.81; 1.9	3.5**	NA
Property C Pb	6	336	217	210	336	Average	NA	NA	NA

**Selected EPC was calculated using laboratory data (not XRF-derived data) due to $r^2 < 0.5$.*
*** Selected HQs for pica exposures could not be calculated for acute HQs calculations, however Intermediate Exposure HQs were calculated and reported here.*
 # = number, mg/kg = milligrams contaminant per kilogram soil, EPC = exposure point concentration, HQ = hazard quotient, CTE = central tendency exposure, RME = reasonable maximum exposure, As = arsenic, Cd = cadmium, Pb = lead, UCL = upper confidence limit, NA = not available due to lack of numerical data or health effects-associated data.

Levels of arsenic were above chronic exposure health guidelines and showed a calculated risk of cancer > 1 out of 1,000,000 on all three properties. The same was true for cadmium where all properties had levels that exceeded the chronic exposure health guideline. Pica hazard quotients for arsenic on properties A, B, and C were 0.24, 0.84, and 0.21, respectively. Pica hazard quotients for cadmium on properties A, B, and C were 17, 9.6, and 3.5, respectively. Hazard quotients for lead could not be derived due to there being no health-based comparison values.

5.2.2.1. Lead

Accumulation of lead in the body can cause damage to the nervous or gastrointestinal system, kidneys, red blood cells, and other systems. Young children, before and after birth, are at greatest risk of adverse health effects from lead exposure. Specifically, lead may adversely affect fetal development, contributing to learning difficulties and stunted growth. In adults, evidence of neurological and cardiovascular effects have been identified with BLLs around 5 µg/dL. In both children and adults, evidence of hematological, immunological, endocrine, body weight, and musculoskeletal effects has been identified with BLLs around 10 µg/dL [ATSDR]. Importantly, the CDC has not identified a safe blood lead level in children or adults.

The Caney community was evaluated for potential increased child blood lead levels based on several risk factors. Factors associated with the increased risk of higher blood lead levels include

- children younger than six,
- living in homes built before 1978, and especially before 1950,
- age of infrastructure (i.e., plumbing),
- living in rental housing,
- poverty,
- and people living in the “lead belt” region (where lead mining and processing were historically active) in the United States.

The ATSDR continues to work collaboratively with the EPA to reduce or prevent exposures to lead, especially in children as they can become exposed more commonly via hand-to-mouth activity while playing outside, while contacting indoor dust, or when eating after handling material (including soil) that may have high levels of lead in it. As mentioned previously, the CDC recently lowered the BLRV to 3.5 µg/dL. Due to there being no known safe level of blood lead in children, the effort to reduce exposures to lead as much as possible is vital.

Determining possible outcomes from lead exposure

ATSDR used the IEUBK model to estimate blood lead levels in children up to 7 years old for ranges of lead levels in soil (Table 4). The same data are also provided as a graph in Figure 4. IEUBK-Modeled Blood Lead Levels at Various Soil Lead Levels (100, 200, and 400 mg/kg).

. The IEUBK’s default value for the Absorption Fraction for Soil and Dust is 60%, which is similar to the reported site-specific bioaccessibility value of 64% (Table A5). All properties evaluated have a greater than 5% chance of childhood blood lead levels exceeding the CDC BLRV of 3.5 µg/dL, and many properties with soil lead greater than 200 mg/kg exceed the prior BLRV of 5 µg/dL.

Table 4. Estimated probabilities of blood level exceedances for various soil lead levels at Caney properties.

Range of Soil Lead Levels at Caney Properties (mg/kg)	Number of Properties with Average Soil Lead Levels in Range	Estimated Probability (%) of exceeding a Blood Lead Level of 3.5 µg/dL**	Estimated Probability (%) of exceeding a Blood Lead Level of 5 µg/dL**	Estimated Blood Lead Level ranges (µg/dL) for ages 1-7
<100	1*	<6.3	<1.1	<2.1
100 – 200	16	6.3 – 18.7	1.1 – 5.0	1.4 – 3.0
200 – 400	144	18.7 – 49.0	5.0 – 21.7	1.7 – 4.9
>400	127	>49.0	>21.7	>2.5

* This sample was 91.9 ppm, which is greater than the average soil concentration with a predicted 5% chance of blood lead level exceeding 3.5 µg/dL.

** Blood lead levels were calculated using the IEUBK model (Version 2.0) with default assumptions. The model was run with results displayed as a density curve for ages 12 – 72 months (5 years), geometric standard deviation (GSD) of 1.6, and target BLL of 5 µg/dL and then at 3.5 µg/dL.

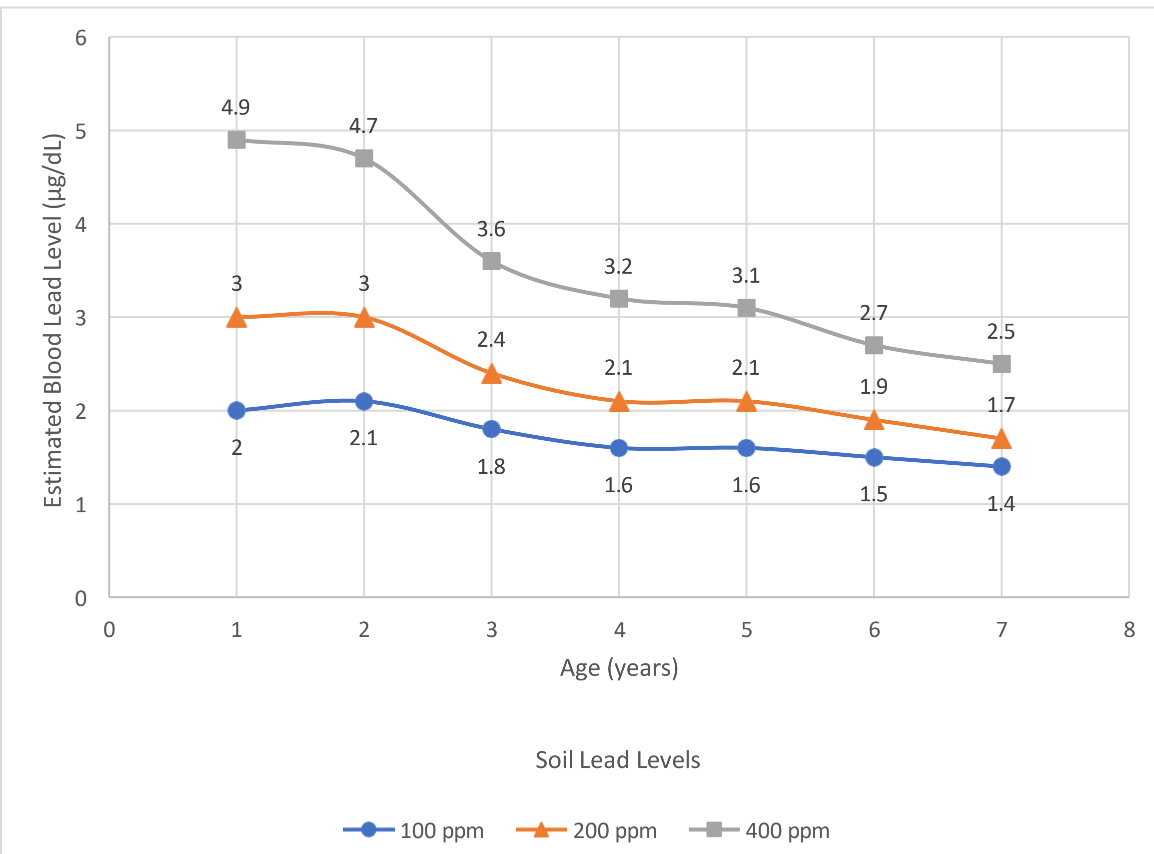

Figure 4. IEUBK-Modeled Blood Lead Levels at Various Soil Lead Levels (100, 200, and 400 mg/kg).

Many factors influence lead exposure, uptake, and potential for health effects, many of which can be controlled by the choices we make. For example, eating healthy foods can help slow down how the body takes in lead and helps prevent lead poisoning. Also, lead exposure may occur from eating fruits or vegetables grown in soil that contains lead [ATSDR]. Lead in dirt and dust can coat the surface of fruits or vegetables and could be taken up into fruits and vegetables themselves. Also, other sources of dust may contribute to lead exposure, so it is important to prevent exposure by proper frequent handwashing (e.g., after playing or exercising outside, touching indoor dust, etc.), keeping toys clean (e.g., wiping toys after getting dirty outside), and wet mopping hard floors, etc. The EPA generally recommends that special gardening practices be used when soil lead levels are greater than 100 mg/kg [EPA]. Community members can protect their health by following good gardening practices, cleaning their produce, and other simple practices to reduce their exposure to lead in soil. Gardening alone can be beneficial as it is a healthy form of outdoor activity, which includes exercise and the consumption of healthy fruits and vegetables.

5.2.2.2. Arsenic

Chronic arsenic soil exposure duration (more than a year)

The EPA reference dose (RfD) of 0.06 µg/kg/day is based on several studies. These studies suggest that if arsenic exposure doses were >0.174 µg/kg/day, >0.171 µg/kg/day, >0.237 µg/kg/day, or >0.315 µg/kg/day there would be a >5% chance of various health outcomes such as diabetes, ischemic heart disease, having developmental neurocognitive impacts, and fetal, newborn, and infant health outcomes, respectively [EPA]. Table 6, Table 7, and Table 8 show the estimated arsenic exposure doses for Properties A, B, and C. Table A13, Table A15, and Table A17 show that HQs for acute arsenic exposures are all <1 for those at risk of CTE, RME, and pica exposure to arsenic in soil at these three properties and are not a concern for health effects.

Table 6 Property A Arsenic Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day
Birth to <1 year	0.06	0.14	-
1 to <2 years	0.064	0.13	1.2
2 to <6 years	0.032	0.08	0.8
6 to <11 years	0.02	0.05	-
11 to <16 years	0.01	0.02	-
16 to <21 years	0.008	0.01	-
Adult	0.004	0.01	-

Table 7 Property B Arsenic Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day
Birth to <1 year	0.21	0.48	-
1 to <2 years	0.22	0.43	4.2
2 to <6 years	0.11	0.29	2.8
6 to <11 years	0.07	0.17	-
11 to <16 years	0.03	0.06	-
16 to <21 years	0.03	0.05	-
Adult	0.01	0.03	-

Table 8 Property C Arsenic Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day
Birth to <1 year	0.053	0.12	-
1 to <2 years	0.056	0.11	1.1
2 to <6 years	0.028	0.073	0.7
6 to <11 years	0.017	0.042	-
11 to <16 years	0.0084	0.015	-
16 to <21 years	0.0072	0.013	-
Adult	0.0036	0.0085	-

5.2.2.3. Cadmium

Chronic cadmium soil exposure duration (more than one year)

The chronic MRL of 0.1 µg/kg/day for cadmium is based on the effect level of 0.33 µg/kg/day and an uncertainty factor of three for human variability for a renal/urinary effect. The individual dose-response functions from each study [Buchet, Järup, Suwazono] were implemented to arrive at estimates of the internal dose (urinary cadmium expressed as µg/g creatinine) corresponding to probabilities of 10% excess risk of low molecular weight proteinuria (urinary cadmium dose, UCD_{10}). The lowest UCD_{10} (1.34 µg/g creatinine) was estimated from the European database; and the 95% lower confidence limit on this UCD_{10} ($UCDL_{10}$) of 0.5 µg/g creatinine was considered as the point of departure for the MRL.

Exposure to the highest estimated (RME) doses of cadmium in children from birth to 6 years at properties A and B may cause a small risk of harm to the kidney. Table 9 , Table 10 and Table 11 show that the children with high (RME) cadmium exposure levels may exceed the lowest effect level of 0.33 µg/kg/day for proteinuria (protein in the urine). Cadmium exposure in children 6 to 11 years old approaches the lowest effect level and presents some concern also. Individuals with diabetes may be more sensitive to the kidney toxicity of cadmium.

Table 9 Property A Cadmium Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day
Birth to <1 year	0.4	0.94	-
1 to <2 years	0.42	0.86	8.5
2 to <6 years	0.21	0.57	5.6
6 to <11 years	0.13	0.32	-
11 to <16 years	0.058	0.11	-
16 to <21 years	0.049	0.093	-
Adult	0.026	0.065	-

Table 10 Property B Cadmium Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day

Birth to <1 year	0.22	0.53	-
1 to <2 years	0.24	0.48	4.8
2 to <6 years	0.12	0.32	3.1
6 to <11 years	0.07	0.18	-
11 to <16 years	0.03	0.06	-
16 to <21 years	0.03	0.05	-
Adult	0.02	0.04	-

Table 11 Property C Cadmium Doses Table

Exposure Group	CTE Dose µg/kg/day	RME Dose µg/kg/day	Soil-Pica Dose µg/kg/day
Birth to <1 year	0.081	0.19	-
1 to <2 years	0.087	0.17	1.7
2 to <6 years	0.042	0.12	1.1
6 to <11 years	0.026	0.066	-
11 to <16 years	0.012	0.023	-
16 to <21 years	0.01	0.019	-
Adult	0.005	0.013	-

Intermediate cadmium soil exposure duration (two weeks to one year)

The intermediate MRL of 0.5 µg/kg/day of cadmium is based on the effect level of 50 µg/kg/day and an uncertainty factor of 100 for extrapolation from animals to humans and for human variability for a skeletal effect. At the lowest cadmium dose tested, 200 µg/kg/day, a number of skeletal alterations were observed [Brzóska 2005a , Brzóska 2005b, Brzóska 2005c]. The benchmark dose (BMD) and the 95% lower confidence limit (BMDL) are an estimate of the doses associated with a change of 1 standard deviation from the control. The $BMDL_{1sd}$ of 50 µg/kg/day of cadmium estimated from the 9-month lumbar spine data set was selected as the point of departure for the MRL. Exposure to cadmium doses greater than 50 µg/kg/day might put people at risk for certain harmful health effects. The cadmium doses for soil pica at property A in the table above (Table 9) are approaching the effect level of 50 µg/kg/day. If soil-pica occurs for several months or more, the child may be approaching levels of exposure that cause harmful effects from cadmium such as weakened bones, poor coordination, and altered blood chemistry, such as decreased hematocrit and hemoglobin [[ATSDR]].

Acute cadmium soil exposure duration (less than two weeks)

The studies available in ATSDR's toxicological profile for cadmium [[ATSDR]] were insufficient to derive an acute oral MRL for cadmium. A cadmium dose of 200 µg/kg/day was the lowest dose found to show health effects in the studies that were available. The cadmium doses in Table 9 through 11 for all the Caney Kansas properties sampled are far enough below this level that health effects are not expected from exposure to the soil for less than two weeks based on the limited information in the cadmium toxicological profile.

5.3. Other sources of contaminant exposure

5.3.1. Outdoor or Indoor Air Evaluation

The nearest outdoor air quality monitoring station that is part of the EPA's National Ambient Air Monitoring Network is more than 60 miles away in Picher, Oklahoma. Therefore, screening of historical contaminant levels in the outdoor air is not possible. There are no indoor air data available. Outdoor air leading to indoor contamination is considered to be a potential pathway of exposure from the site's main sources of contamination. The contribution of outdoor and indoor air exposure to lead is largely accounted for in the IEUBK model, which assumes the source of 70% of lead in indoor dust is outdoor soil. Other sources of lead may contribute to indoor and outdoor air contamination. If other concerns arise, such as concern that the home may have other sources of lead (e.g., lead-containing dust, especially from moldering leaded paint), sampling indoor air or dust might help indicate if these other sources of metals are contributing to recontamination. However, conducting new air sampling efforts could not be used as an indicator of remedial effectiveness due to the absence of historical data.

5.3.2. Migrating Dust

Now that most properties have been remediated, the impact of measuring migrating dust would not reflect historical exposures. Some data might provide a glimpse into current or potential exposures. Also, the Integrated Site Assessment (ISA) states that fugitive dust from contaminated soils may impact off-site areas [KDHE]. It is likely that contaminated soil impacts to house dust will be minimal following remediation and removal of contaminated soil, however citizens should be aware that fugitive dust may have impacted the dust in their attic and may benefit from taking extra precautions to ensure that dust from these locations is not disturbed.

5.3.3. Surface Water Evaluation

All residences east of the Little Caney River to Coffeyville and north to at least Havana receive their water from the Caney public water supply (surface water from the Little Caney River, within a 4-mile radius) or the Montgomery County Rural Water District #5 (surface water from the Verdigris River outside a 4-mile radius). Also, surface water runoff at the original smelter site has been reported to flow mainly to the West and into a drainage that can become a tributary to Cheyenne Creek during high flows. Cheyenne Creek is also a tributary to the Little Caney Creek [KDHE]. Lead levels in surface water were measured during the preliminary assessment in 1991 at 0.011 mg/L, which is slightly above the trigger level in EPA's drinking water rule (i.e., Lead and Copper Rule) of 0.010 mg/L [EPA]. Recent water quality reports (Table 3) suggest that contaminant migration in the past is not impacting the community's drinking water supply.

5.3.4. Other Possible Sources

Some other historical sources of lead include the use of leaded gasoline, which was phased out in the early 1980s; and lead-containing paint, which was on the market until around 1978 when lead-based paint was phased out. Homes with plumbing that was installed before 1986 may have lead-containing materials that may leach lead into water that is used for cooking and drinking. Other common exposures are usually the result of ingestion of lead-contaminated soil in the yard, or lead-contaminated dust in the home that may be a result of an occupant's occupation (e.g., mining) or hobby (e.g., ammunition loading, creating and restoring stained glass, refinishing furniture, etc.).

5.4. Summary of Limitations and Uncertainties

Potential limitations and uncertainties include a lack of data on the levels of lead in private well water, levels of lead in or on produce, levels in the air, or even in fish that may be caught in local ponds and consumed. Some soil locations throughout Caney may have been overlooked for lead sampling, or perhaps areas that may become accessible, especially for children, may have been missed or permission for access denied.

Also, there may be old or unregistered wells that may be in use but are not reported. Another significant source of lead exposure that could not be reviewed, due to lack of data, includes measuring lead in a household's drinking water supply that may not originate from the water supply's infrastructure but might be due to old plumbing in the home, or an old service line leading into the house. It is also possible that other sources may contribute to the recontamination of the soil (e.g., lead-based paint flaking off the exterior of the house contaminating the soil). It is important to recognize these limitations so that individuals understand the importance of continuing to be vigilant about protecting themselves from lead exposure.

6. Conclusions

The ATSDR concludes that past, current, and possibly future contact with soil at properties around the site may harm people's health. Children are especially at greater risk for lead exposure from accidentally touching, eating, or breathing lead-contaminated yard soil.

The CDC has not identified a safe level of lead in blood and advises minimizing lead exposure when possible. Residents of all ages who live on remediated properties (with soil lead levels <200 mg/kg) are less likely to experience adverse health effects from lead exposure than properties with higher lead levels in soil. The IEUBK predicts that a soil lead level ≥200 mg/kg is likely to result in a peak average blood lead level (in children around 2 years old) of 3.4 µg/dL (Figure 4). IEUBK-Modeled Blood Lead Levels at Various Soil Lead Levels (100, 200, and 400 mg/kg).

Some homes may have soil lead above 200 mg/kg but have not yet received remediation. Three hundred forty-four properties with lead in soil above 400 mg/kg have been remediated and about an additional 630 properties with lead in soils above 200 mg/kg have been or will be remediated to ensure reduced exposures to lead-contaminated soil throughout the community.

Some locations with potential lead sources were not sampled (e.g., inaccessible locations). There may be areas in and around the town with unknown soil lead levels that may become a place where children start to play. This is of particular concern as soil lead concentrations in some parts of the city reached as high as 33,400 mg/kg. Some properties adjacent to the smelting site also had other metals (i.e., arsenic and cadmium) reach concentrations that might be harmful if chronically exposed over years (Table A7). The only contaminant that was found at all three sites, and in all samples, was lead. This suggests that removal of any lead contaminated waste will also remove the other metals that may have impacted other residential properties.

Table A1, Table A2, and Table A3 in this document summarize the various sampling phases. Most of these properties have been remediated, or will likely be within the next year or two, further reducing risk of lead exposure to residents. Understanding exposure risks, especially for children, to contaminated soils in accessible areas throughout this community is likely to help protect them.

Recommendations for each property depend on their remediation status. Some properties have soil lead levels below 200 mg/kg and do not require remedial efforts. There are properties that had soil lead levels above 200 mg/kg but have already had their property remediated. However, for properties that still have soil lead levels above 200 mg/kg, ATSDR recommends that the property owners complete remediation.

ATSDR cannot conclude whether consuming local produce, fish, or well water or breathing outdoor air in Caney, KS could harm people's health. These possible exposure pathways are considered unknown as the data available are insufficient to evaluate these pathways directly.

Gardening and consuming produce grown in lead-contaminated soil may increase exposure to lead. There are no data showing that produce in Caney are taking up lead from the soil; however, lead-containing dust on the surface of the produce may become a source of exposure. Also, fish caught in the local ponds may be a source of exposure if the fish also contain elevated levels of lead.

Outdoor air is considered to be a potential pathway of exposure. However, screening of historical lead levels in the outdoor air is not possible. There is also no indoor air data available for lead. Other sources of lead may contribute to indoor air contamination including the release of lead-containing dust, especially from moldering leaded paint.

Migrating lead-containing soil dust is considered a potential exposure pathway. However, now that most properties have been remediated, the risk of such an intrusion is less likely to occur. Citizens should be aware that fugitive dust may have impacted the dust in their attic and may benefit from taking extra precautions to ensure that dust from this location is not disturbed.

Lead exposure from water is not considered a completed exposure pathway. All residences east of the Little Caney River to Coffeyville and north to at least Havana receive their water from the Caney public water supply (surface water from the Little Caney River, within a 4-mile radius) or the Montgomery County Rural Water District #5 (surface water from the Verdigris River outside a 4-mile radius). Also, surface water runoff at the original smelter site has been reported to flow mainly to the West. Lead levels in surface water were measured during the preliminary assessment in 1991 at 0.011 mg/L, which is slightly above the EPA's drinking water rule (i.e., Lead and Copper Rule) of 0.010 mg/L. Recent water quality reports (Table 3) suggest that contaminant migration in the past is not impacting the community's drinking water supply currently.

Exposure to the highest estimated doses of cadmium in children from birth to 6 years at properties A and B may cause a small risk of harm to the kidneys. These properties also were included in the list of properties that were remediated due to average soil lead levels being > 200 mg/kg. Table 9 and Table 10 show that children with high cadmium exposure levels may exceed the lowest effect level of 0.33 µg/kg/day for proteinuria (protein in the urine). Cadmium exposure in children 6 to 11 years old approaches the lowest effect level and presents some concern also. Individuals with diabetes may be more sensitive to the kidney toxicity of cadmium [ATSDR]. Smoking cigarettes or breathing cigarette smoke increases cadmium exposure, making smokers a sensitive population for potential health effects from cadmium [ATSDR].

Exposure to the highest estimated doses of arsenic from soil in young children at property B may cause a small increased risk of cognitive decline (e.g., decreased IQ score) and newborn and infant health outcomes. The highest estimated arsenic exposure doses from properties A, B, and C are a concern for increased cancer risk. The estimated cancer risks from many years of exposure range from 1 to 14 excess cancer cases out of 10,000 people. Exposure to arsenic is associated with lung cancer, nonmelanoma skin cancers, and bladder cancer [EPA]. There is limited evidence for association with kidney, liver, and prostate cancers.

7. Recommendations and Public Health Action Plan

ATSDR recommends EPA to continue their remediation efforts in areas (to include local schools, etc.) that are known to be a hazard to the community. ATSDR recommends the EPA and the local government to continue outreach efforts on reducing exposures to contaminated soil for residents whose properties have not yet been remediated, until the site has been removed from the superfund list. ATSDR recommends the EPA and the Local Health Agency to continue remediating contaminated soils throughout the community where people can become exposed, including public spaces like community gardens, schools, childcare facilities, parks, and playgrounds. Continued effort by the local health agency to provide resources to residents (e.g., factsheets) and community-wide public education about lead hazards may promote a culture of awareness and safety. Taking time to observe and/or commemorate the various milestones and successes within the community may promote ongoing engagement and reinforce shared progress.

Considering the uncertainties associated with impacts on childcare centers, and that some of the above-mentioned facilities are located close to the sites of concern, they may be impacted by the translocation of mine waste onto or near these properties. ATSDR recommends childcare facilities be given (e.g., from the local health agency) educational materials on a semi-regular basis (e.g., once a year, once every other year) so that lead awareness will continue to be a focus.

The CDC recommends blood lead testing for children enrolled in Medicaid at ages 12 and 24 months, or ages 24-72 months if they have never been screened as well as for children not enrolled in Medicaid with known exposure to lead sources. If a child's venous blood lead level is ≥ 3.5 µg/dL, CDC recommends healthcare providers perform the following: conduct a detailed exposure history, evaluate the child's diet focusing on calcium and iron intake, check for iron deficiency, monitor the child's developmental milestones, and refer caregivers to supportive services as needed. If blood lead levels reach 20 µg/dL, CDC recommends further testing within two weeks to one month, along with environmental investigations to identify and mitigate lead sources [CDC].

One of the most common questions from concerned citizens is, "What can I do to protect myself and my family?" ATSDR recommends that all community members take personal actions to minimize contact with lead from all sources. Fact sheets and other resources referenced below can help you learn what you can do to protect yourself, your family, and your community.

Links to other resources:

- U.S. Environmental Protection Agency (EPA) Handbook: Protect Your Family from Lead in Your Home (https://www.epa.gov/lead/protect-your-family-lead-your-home-english)
- EPA website: Protect Your Family from Sources of Lead (https://www.epa.gov/lead/protect-your-family-sources-lead)
- CDC's National Center for Environmental Health website: Childhood Lead Poisoning Prevention (https://www.cdc.gov/nceh/lead)
- CDC's resource for lead in drinking water (https://www.cdc.gov/lead-prevention/prevention/drinking-water.html)

8. Who Prepared the Document

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10. Appendices

10.1. Appendix A – Tables

Table A1. Summary of 2015 surface soil lead data of all sampled properties (279 total properties) [EPA].

Screening Results (Pb)	Number of Properties	Percent of Total Properties Tested
All sampled areas <400 mg/kg	136	49%
At least one sample area >400 mg/kg (excluding drip zones and road easements)	73	26%
>400 mg/kg in drip zone or road easement only	70	25%

Table A2. Summary of 2016-2018 surface soil lead data of all sampled properties (713 total properties) [EPA 2020].

Screening Results (Pb)	Number of Properties	Percent of Total Properties Tested
All sampled areas <400 mg/kg	338	47%
At least one sample area >400 mg/kg (excluding drip zones and road easements)	248	35%
>400 mg/kg in drip zone or road easement only	127	18%

Table A3. Summary of 2019 surface soil lead data of all sampled properties (64 total properties) [EPA 2020].

Screening Results (Pb)	Number of Properties	Percent of Total Properties Tested
All sampled areas <400 mg/kg	39	60%
At least one sample area >400 mg/kg (excluding drip zones and road easements)	24	38%
>400 mg/kg in drip zone or road easement only	1	2%

Table A4. Summary of subsurface soil lead levels (EPA, 2016b)

EPA Property ID	Sample Location	Composite Surface Soil Lead Sample Value (mg/kg)	0-12 Inches below surface soil lead value (mg/kg)	12-24 inches below surface soil lead value (mg/kg)
0005	Cell 4	279	23	26
0011	Cell 1	1,074	**2,937**	59
0029	Cell 3	1,338	65	43
0037	Cell 4	418	112	14
0038	Cell 1	623	478	35
0055	Cell 1	727	446	49
0064	Cell 2	987	39	38
0067	Cell 2	737	54	34
0087	Cell 4	551	201	212

Bolded value indicates subsurface soil lead concentration exceeds composite surface soil lead concentration.

bgs Below ground surface

EPA U.S. Environmental Protection Agency

ID Identification

mg/kg Milligrams per kilogram

Table A5. Summary of lead *in vitro* bioaccessibility assay (IVBA) results ordered from highest XRF reading to lowest and associated cadmium, lead, and zinc soil concentrations from certified laboratory measures (EPA, 2020).

EPA Property ID	Sample Location	XRF Lead Results (mg/kg)	Laboratory Cadmium Concentration (mg/kg)	Laboratory Lead Concentration (mg/kg)	Laboratory Zinc Concentration (mg/kg)	Bioaccessible Lead, IVBA (%)
1090	Cell 1	33,400	31	28,500	37,400	66.7
249	Sidewalk 2 (under brick)	10,200	38.4	9,260	30,900	55.4
942	Sidewalk (under brick)	6,687	85.4	7,300	85,800	54.5
409	Sidewalk (under brick)	5,943	28.6	5,700	14,900	59.3
1104	Cell 1	3,508	30.4	2,840	12,900	56.7
1102	Cell 1	3,414	50.4	3,180	21,400	60.8
1108	Cell 1	888	7.4	818	4,410	60.6
1097	Sidewalk (under brick)	719	9.4	801	3,990	64.4
1063	Cell 4	691	7.6	746	2,360	61.4
1102	Cell 3	621	16.3	619	4,970	55.6
1030	Landscaping	594	4.8	609	1,440	67.3
1027	Cell 1	571	4.7	605	2,130	62
249	Sidewalk 1 (surface)	562	9	532	3,770	64.3
1102	Cell 2	549	5	543	2,110	61.1
1052	Cell 1	547	7.4	518	3,160	61
1100	Cell 1	521	5.5	500	2,880	61
1038	Cell 1	480	3.5	480	1,200	69.2
1095	Cell 1	453	4.5	364	1,180	69.8

1107	Cell 1	421	5.9	342	1,960	75.7
1030	Cell 2	403	10.9	423	2,550	62.4
1023	Cell 1	378	9.6	382	3,270	59.7
1006	Cell 1	359	7.8	372	2,330	63.2
1106	Cell 1	354	3.3	236	1,970	62.3
1093	Cell 1	348	7.1	331	2,420	64
1039	Cell 1	340	3.7	356	1,360	62.9
1052	Cell 2	317	8.5	299	4,230	66.9
1097	Cell 1	299	6	244	1,750	54.1
128	Sidewalk (surface)	286	5.9	278	2,370	55.8
1004	Sidewalk (under brick)	245	3.2	231	1,190	65.4
1094	Cell 1	183	3	154	1,100	67.5
1103	Cell 1	166	2.4	122	1,920	78.4
1109	Driveway 1	166	4.8	112	1,260	59.3
1109	Driveway 2	140	3.3	103	1,090	59.6
1109	Cell 2	137	3.5	108	925	63.6
1096	Cell 1	118	2.2	85.6	909	86.7
1109	Cell 1	78	1.2	52.5	520	69.5

XRF: x-ray fluorescence is an analytical technique that determines the elemental composition of material by measuring the reflection of x-rays from various materials. XRF is useful for rapid, on-site testing, but they are often used as screening tools. Laboratory-based tests are required for higher precision measurements.

Table A6. Summary of all XRF lead analyses from the 2015 dataset [EPA 2016b].

Total # of samples:	1837
Highest reported concentration	6,443 mg/kg
Minimum reported concentration	12 mg/kg
Median concentration	278 mg/kg
Mean concentration	284 mg/kg
Standard deviation	578 mg/kg
Standard error	13 mg/kg

XRF: X-ray fluorescence is an analytical technique that determines the elemental composition of material by measuring the reflection of secondary x-rays from various materials. Link to a source where the statistical terms are defined: https://www.cdc.gov/epiinfo/user-guide/glossary/glossary.html.

Table A7. Property A, arsenic: Residential default combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 10.73 mg/kg along with noncancer hazard quotients and cancer risk estimates

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	6.0E-05	1.0 †	-	1	0.00014	2.3 †	-	1
1 to < 2 years	6.4E-05	1.1 †	-	1	0.00013	2.1 †	-	1
2 to < 6 years	3.2E-05	0.53	-	4	8.4E-05	1.4 †	-	4
6 to < 11 years	2.0E-05	0.33	-	5	4.8E-05	0.80	-	5
11 to < 16 years	9.6E-06	0.16	-	1	1.8E-05	0.29	-	5
16 to < 21 years	8.2E-06	0.14	-	0	1.4E-05	0.24	-	5
Total Child	-	-	1.5E-4 ‡	12	-	-	4.1E-4 ‡	21
Adult	4.1E-06	0.069	2.0E-5 ‡	12	9.7E-06	0.16	1.3E-4 ‡	33

Source: [KDHE]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 6E-05 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 32 $(mg/kg/day)^{-1}$.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table A8. Property A, cadmium: Residential default combined ingestion and dermal exposure doses for chronic exposure to cadmium in soil at 44.7 mg/kg along with noncancer hazard quotients*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.00040	4.0 †	-	1	0.00094	9.4 †	-	1
1 to < 2 years	0.00042	4.2 †	-	1	0.00086	8.6 †	-	1
2 to < 6 years	0.00021	2.1 †	-	4	0.00057	5.7 †	-	4
6 to < 11 years	0.00013	1.3 †	-	5	0.00032	3.2 †	-	5
11 to < 16 years	5.8E-05	0.58	-	1	0.00011	1.1 †	-	5
16 to < 21 years	4.9E-05	0.49	-	0	9.3E-05	0.93	-	5
Total Child	-	-	-	12	-	-	-	21
Adult	2.6E-05	0.26	-	12	6.5E-05	0.65	-	33

Source: [KDHE]

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.

* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 6E-05 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 32 $(mg/kg/day)^{-1}$.

† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table A9. Property B, arsenic: Residential default combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 36.9 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.00021	3.4 †	-	1	0.00048	7.9 †	-	1
1 to < 2 years	0.00022	3.7 †	-	1	0.00043	7.2 †	-	1

2 to < 6 years	0.00011	1.8 †	-	4	0.00029	4.8 †	-	4
6 to < 11 years	6.8E-05	1.1 †	-	5	0.00017	2.8 †	-	5
11 to < 16 years	3.3E-05	0.55	-	1	6.0E-05	1.0 †	-	5
16 to < 21 years	2.8E-05	0.47	-	0	5.0E-05	0.83	-	5
Total Child	-	-	5.1E-4 ‡	12	-	-	>1.0E-3 ‡	21
Adult	1.4E-05	0.24	7.0E-5 ‡	12	3.4E-05	0.56	4.5E-4 ‡	33

Source: [KDHE]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 6E-05 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 32 $(mg/kg/day)^{-1}$.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table A10. Property B, cadmium: Residential default combined ingestion and dermal exposure doses for chronic exposure to cadmium in soil at 25.2 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.00022	2.2 †	-	1	0.00053	5.3 †	-	1
1 to < 2 years	0.00024	2.4 †	-	1	0.00048	4.8 †	-	1
2 to < 6 years	0.00012	1.2 †	-	4	0.00032	3.2 †	-	4
6 to < 11 years	7.2E-05	0.72	-	5	0.00018	1.8 †	-	5
11 to < 16 years	3.3E-05	0.33	-	1	6.4E-05	0.64	-	5

16 to < 21 years	2.8E-05	0.28	-	0	5.2E-05	0.52	-	5
Total Child	-	-	-	12	-	-	-	21
Adult	1.5E-05	0.15	-	12	3.7E-05	0.37	-	33

Source: [KDHE]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0001 mg/kg/day.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table A11. Property C, arsenic: Residential default combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 9.4 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	5.3E-05	0.88	-	1	0.00012	2.0 †	-	1
1 to < 2 years	5.6E-05	0.93	-	1	0.00011	1.8 †	-	1
2 to < 6 years	2.8E-05	0.46	-	4	7.3E-05	1.2 †	-	4
6 to < 11 years	1.7E-05	0.29	-	5	4.2E-05	0.70	-	5
11 to < 16 years	8.4E-06	0.14	-	1	1.5E-05	0.26	-	5
16 to < 21 years	7.2E-06	0.12	-	0	1.3E-05	0.21	-	5
Total Child	-	-	1.3E-4 ‡	12	-	-	3.6E-4 ‡	21
Adult	3.6E-06	0.060	1.8E-5 ‡	12	8.5E-06	0.14	1.2E-4 ‡	33

Source: [KDHE]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 6E-05 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 32 $(mg/kg/day)^{-1}$.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table A12. Property C, cadmium: Residential default combined ingestion and dermal exposure doses for chronic exposure to cadmium in soil at 9.1 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	8.1E-05	0.81	-	1	0.00019	1.9 †	-	1
1 to < 2 years	8.7E-05	0.87	-	1	0.00017	1.7 †	-	1
2 to < 6 years	4.2E-05	0.42	-	4	0.00012	1.2 †	-	4
6 to < 11 years	2.6E-05	0.26	-	5	6.6E-05	0.66	-	5
11 to < 16 years	1.2E-05	0.12	-	1	2.3E-05	0.23	-	5
16 to < 21 years	1.0E-05	0.10	-	0	1.9E-05	0.19	-	5
Total Child	-	-	-	12	-	-	-	21
Adult	5.3E-06	0.053	-	12	1.3E-05	0.13	-	33

Source: [KDHE]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; "-" = indicates that the value could not be calculated and therefore does not exist.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0001 mg/kg/day.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table A13. Property A, arsenic: Default combined ingestion and dermal exposure doses for acute exposure to arsenic in soil at 10.7 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	6.0E-05	0.012	0.00014	0.028	-	-
1 to < 2 years	6.4E-05	0.013	0.00013	0.025	0.0012	0.24
2 to < 6 years	3.2E-05	0.0064	8.4E-05	0.017	0.00080	0.16
6 to < 11 years	2.0E-05	0.0040	4.8E-05	0.0096	-	-
11 to < 16 years	9.6E-06	0.0019	1.8E-05	0.0035	-	-
16 to < 21 years	8.2E-06	0.0016	1.4E-05	0.0029	-	-
Adult	4.1E-06	0.00082	9.7E-06	0.0019	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day.

Table A14. Property A, cadmium: Default combined ingestion and dermal exposure doses for intermediate exposure to cadmium in soil at 44.7 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	0.00040	0.79	0.00094	1.9 †	-	-
1 to < 2 years	0.00042	0.85	0.00086	1.7 †	0.0085	17 †
2 to < 6 years	0.00021	0.41	0.00057	1.1 †	0.0056	11 †
6 to < 11 years	0.00013	0.25	0.00032	0.65	-	-
11 to < 16 years	5.8E-05	0.12	0.00011	0.23	-	-
16 to < 21 years	4.9E-05	0.098	9.3E-05	0.19	-	-
Adult	2.6E-05	0.052	6.5E-05	0.13	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that

the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day. † Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table A15. Property B, arsenic: Default combined ingestion and dermal exposure doses for acute exposure to arsenic in soil at 36.9 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	0.00021	0.041	0.00048	0.095	-	-
1 to < 2 years	0.00022	0.044	0.00043	0.087	0.0042	0.84
2 to < 6 years	0.00011	0.022	0.00029	0.058	0.0028	0.55
6 to < 11 years	6.8E-05	0.014	0.00017	0.033	-	-
11 to < 16 years	3.3E-05	0.0066	6.0E-05	0.012	-	-
16 to < 21 years	2.8E-05	0.0056	5.0E-05	0.010	-	-
Adult	1.4E-05	0.0028	3.4E-05	0.0067	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day.

Table A16. Property B, cadmium: Default combined ingestion and dermal exposure doses for intermediate exposure to cadmium in soil at 25.2 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	0.00022	0.45	0.00053	1.1 †	-	-
1 to < 2 years	0.00024	0.48	0.00048	0.97	0.0048	9.6 †
2 to < 6 years	0.00012	0.23	0.00032	0.64	0.0031	6.3 †
6 to < 11 years	7.2E-05	0.14	0.00018	0.37	-	-
11 to < 16 years	3.3E-05	0.065	6.4E-05	0.13	-	-

16 to < 21 years	2.8E-05	0.055	5.2E-05	0.10	-	-
Adult	1.5E-05	0.030	3.7E-05	0.074	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day.

Table A17. Property C, arsenic: Default combined ingestion and dermal exposure doses for acute exposure to arsenic in soil at 9.4 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	5.3E-05	0.011	0.00012	0.024	-	-
1 to < 2 years	5.6E-05	0.011	0.00011	0.022	0.0011	0.21
2 to < 6 years	2.8E-05	0.0056	7.3E-05	0.015	0.00070	0.14
6 to < 11 years	1.7E-05	0.0035	4.2E-05	0.0085	-	-
11 to < 16 years	8.4E-06	0.0017	1.5E-05	0.0031	-	-
16 to < 21 years	7.2E-06	0.0014	1.3E-05	0.0025	-	-
Adult	3.6E-06	0.00072	8.5E-06	0.0017	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.
* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day.

Table A18. Property C, cadmium: Default combined ingestion and dermal exposure doses for intermediate exposure to cadmium in soil at 9.1 mg/kg along with noncancer hazard quotients*.

Exposure Group	CTE Dose (mg/kg/day)	CTE Noncancer Hazard Quotient	RME Dose (mg/kg/day)	RME Noncancer Hazard Quotient	Soil-Pica Dose (mg/kg/day)	Soil-Pica Noncancer Hazard Quotient
Birth to < 1 year	8.1E-05	0.16	0.00019	0.38	-	-
1 to < 2 years	8.7E-05	0.17	0.00017	0.35	0.0017	3.5 †

2 to < 6 years	4.2E-05	0.084	0.00012	0.23	0.0011	2.3 †
6 to < 11 years	2.6E-05	0.052	6.6E-05	0.13	-	-
11 to < 16 years	1.2E-05	0.024	2.3E-05	0.046	-	-
16 to < 21 years	1.0E-05	0.020	1.9E-05	0.038	-	-
Adult	5.3E-06	0.011	1.3E-05	0.027	-	-

Source: [KDHE]
CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); "-" = indicates that the value could not be calculated and therefore does not exist.; soil-pica = the deliberate, habitual ingestion of large amounts of soil, often by children.

* The calculations in this table were generated using ATSDR's PHAST v2.5.1.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.005 mg/kg/day.

10.2. Appendix B – Figures

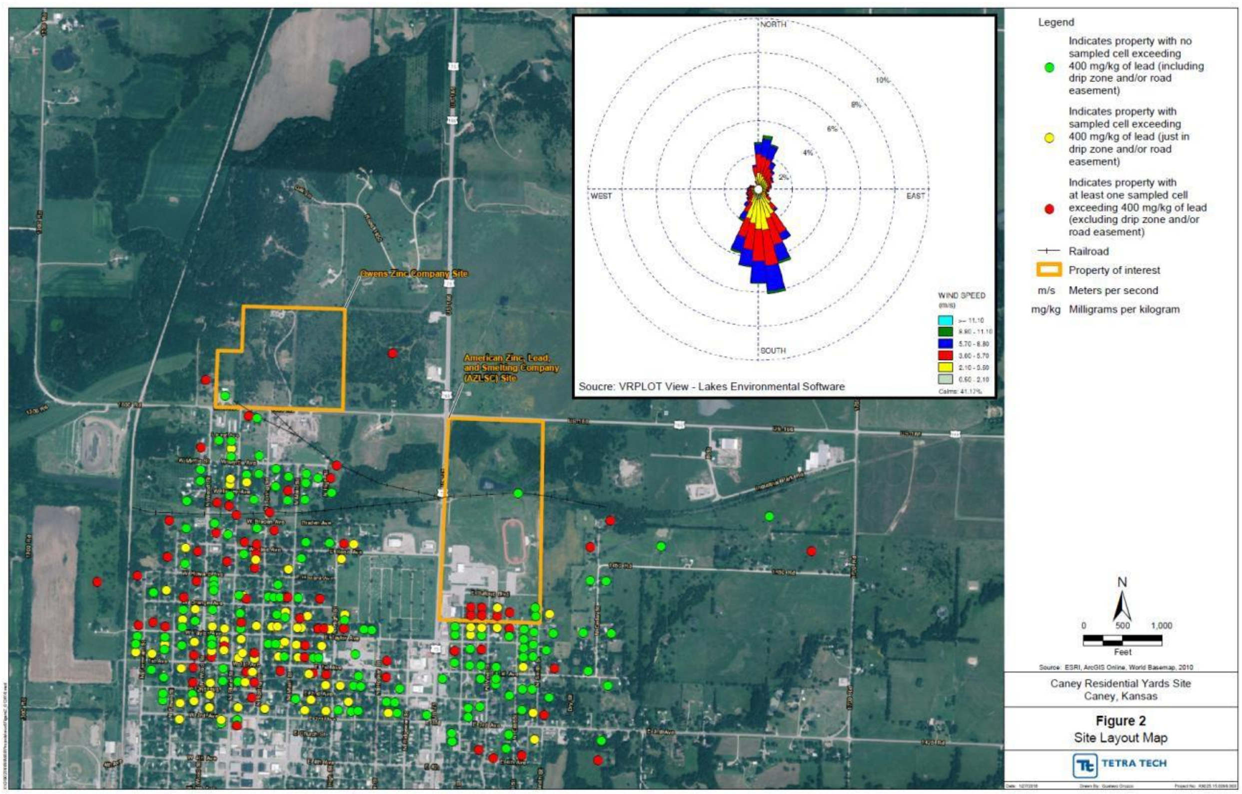

Figure B1. Caney Residential Yards Site; locations where sampling took place in 2015 [EPA].

10.3. Appendix C – Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
AZLS	American Zinc, Lead and Smelting
BLL	Blood Lead Level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CV	Comparison Value
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
FIA	Final Integrated Assessment
HRS	Hazard Ranking System
IEUBK	Integrated Exposure Uptake Biokinetic Model
ISA	Integrated Site Assessment
KDHE	Kansas Department or Health and Environment
mg/kg	milligram per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHANES	National Health and Nutrition Examination Survey
NPL	National Priority List
PA	Preliminary Assessment
PHA	Public Health Assessment
ppb	Parts per billion
PRP	Potential Responsible Party
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization act
SI	Site Inspection
SOP	Standard Operating Procedure
XRF	X-ray Fluorescence