



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION 7**

11201 Renner Boulevard  
Lenexa, Kansas 66219

Apr 29, 2021

**MEMORANDUM**

**SUBJECT:** Data Assessment and Recommended Soil Lead Cleanup Level for Viburnum Trend Lead Haul Roads, Operable Unit 02 Site  
Iron County, Viburnum, Missouri

**FROM:** Ann Durham Jacobs, Human Health Risk Assessor  
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**TO:** Kirk Mammoliti, On-Scene Coordinator  
Response and Removal North Section  
Superfund and Emergency Management Division

As requested, we have evaluated soil data and recommend the following soil cleanup level for the Viburnum Trend Lead Haul Roads site in Viburnum, Missouri. If you have any questions regarding this review and recommendations, please contact Ann Jacobs (x7930).

**Background**

The site is located in northwestern Iron County, with smaller portions within Crawford and Washington counties, in southeastern Missouri. It is part of what is commonly known as the New Lead Belt mining district, or Viburnum Trend, where lead production began around 1960. The Doe Run Resources Corporation – Viburnum Division (formerly St. Joe Minerals Corp. – Viburnum) is located in and near the city of Viburnum. The Viburnum Division includes four mines where ore was brought to the surface (*see link to fact sheet and site map online at: [www.epa.gov/mo/missouri-cleanups](http://www.epa.gov/mo/missouri-cleanups)*). During construction, development, and early operation of these mines, it was not uncommon for lead-contaminated materials, such as tailings and/or poor rock, to be used for construction materials in the building of Viburnum, which was done by the St. Joe Minerals Corp. to support mining operations. As a result of mining-related activities that have occurred in and around the city, lead and lead compounds have been released into the environment in quantities that present a risk to public health and welfare.

The EPA identified Doe Run Resources Corporation, or Doe Run, as the Potentially Responsible Party (PRP) for the lead contamination found at this site. Beginning in 2005, the EPA and Doe Run entered into an agreement for Doe Run to begin cleaning up lead-contaminated residential properties in Viburnum. Lead is the main contaminant of concern at this site, which was likely distributed throughout the city during decades of mining, milling, and transporting of lead ores and concentrates.

**Evaluation of Site Data**

Beginning in November 2020, the EPA began an assessment of previously sampled properties and initial assessment at unsampled properties in accordance with the Superfund Lead Contaminated Residential



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Sites Handbook (EPA, 2003). During the assessment, the EPA sampled 119 residential properties within the site boundaries. The sampling results identified 69 properties with surface soil lead contamination  $\geq 400$  ppm. Sampling access was denied, or property owners could not be reached, at 27 residences where surface soil lead concentrations  $\geq 400$  ppm were previously identified in 2006. Sampling access was denied, or property owners could not be reached, at seven residences that had not been previously assessed. The EPA will continue efforts to assess these properties. The EPA data review has identified 377 residential properties within the site boundaries. The summary table below provides a list and description of properties included in EPA's assessment and data review.

**Table 1.** Property data review and assessment status summary

Property Data Review and Assessment Result		# of properties	Total
Properties meeting the criteria for this Removal Action	Property with surface soil lead > 400 ppm but < 1,200 ppm and sensitive population with Elevated Blood Lead	1	25
	Property with surface soil lead > 400 ppm but < 1,200 ppm and sensitive population	7	
	Property with surface soil lead > 1,200 ppm identified during the EPA assessment	15	
	Property with surface soil lead > 1,200 ppm identified during Doe Run Preliminary Assessment/Site Inspection (PA/SA)	2	
To be addressed in the future	Property with surface soil lead > 400 ppm but < 1,200 ppm and no sensitive population identified during the EPA assessment	46	76
	Property with surface soil lead > 400 ppm but > 1,200 ppm and no sensitive population Identified during Doe Run PA/SA	30	
Yet to be assessed	Property that has not been assessed by the EPA or Doe Run	7*	
No planned action currently	Property with surface soil lead <400 ppm	169	
	Property fully remediated by Doe Run	100	

\*Row includes properties where either sampling access was denied, or the property owner could not be reached.

In December 2020, 30 surface soil samples were collected to assess lead bioaccessibility using the most current *in vitro* bioaccessibility assay method and data analysis recommendations (EPA, 2015, 2021). The purpose of collecting these samples was to determine if soil lead found at the Viburnum site was more or less bioavailable than the default value of 60% relative bioavailability used in the Integrated Exposure Uptake Biokinetic Model (IEUBK) model (EPA, 1994a). Samples with laboratory or XRF measured concentrations between 248 ppm and 691 ppm of lead were examined because they are the concentrations where remediation decisions require more precision. Results are presented below.

**Table 2. Lead Bioaccessibility Results**

Number of Samples	30
Arithmetic Mean of Lead Concentrations	430 ppm <sup>a</sup>
Minimum Lead Concentration	248 ppm
Maximum Concentration	691 ppm
Arithmetic Mean of the Bioaccessible Fraction	0.72
Range of Bioaccessible Fraction	0.57 to 0.83
Standard Deviation of Bioaccessible Fraction	0.05
Arithmetic Mean of the Estimated Relative Bioavailability	0.61 <sup>b</sup>
Range of Relative Bioavailability	0.47 to 0.7
Standard Deviation of the Estimated Relative Bioavailability	0.05
Arithmetic Mean of Estimated Absolute Bioavailability	0.3 <sup>c</sup>
Range of Absolute Bioavailability	0.23 to 0.35
Standard Deviation of the Absolute Bioavailability	0.02

<sup>a</sup> Total Lead in Sieved Portion as Reported with Bioaccessibility Results

<sup>b</sup> Relative Bioavailability (RBA) =  $0.878 \times \text{Bioaccessible Fraction} - 0.028$

<sup>c</sup> Absolute Bioavailability (ABA) =  $\text{RBA} \times 0.5$

**Absolute bioavailability (ABA):** Fraction of an ingested dose of the contaminant lead that is absorbed from the gastrointestinal tract and enters the blood and tissues.

**Relative bioavailability (RBA):** Ratio of the ABA of the lead in the medium of interest to that of the same contaminant in the medium used to dose the test organism in the oral toxicity studies.

**In vitro bioaccessibility (IVBA):** Fraction of total amount lead in a soil sample that is soluble in a gastric-like (i.e., low pH) extraction medium.

The range of the estimated relative bioavailability was 0.57 to 0.83, with an arithmetic mean of 61 percent. The standard deviations of the bioaccessible fraction and the estimated relative bioavailability were 0.05, indicating that the data are clustered closely around those estimates of the mean and that the ranges of those estimates are relatively small. Given the low variability in the data, we can be confident that the estimates of RBA and ABA are representative of site conditions and consistent with the default IEUBK model parameters. The estimated relative bioavailability of lead measured at the Viburnum site is not significantly different than the default value for the IEUBK model of 60 percent, therefore an adjustment to the cleanup level to consider a more or less bioavailable form of lead is unnecessary.

### **Recommended Soil Cleanup Level for Lead**

The current residential soil removal management level and screening level for lead are 400 ppm. Because this value has been used at other residential lead sites in Region 7, and the site-specific *in vitro* bioaccessibility assay results are consistent with the default RBA, it is appropriate to use 400 ppm as a residential soil lead cleanup level at the Viburnum Lead Haul Roads site. This cleanup level is based on the Office of Solid Waste and Emergency Response (OSWER) 1994 and 1998 soil lead Directives (EPA, 1994b, 1998), which identify 10 µg/dL as the blood lead level of concern.

However, since those Directives were issued, increasing evidence has shown that blood lead levels below 10 µg/dL may also have negative health impacts, particularly in young children. Comprehensive reviews of the updated human health scientific literature are presented in the 2012 National Toxicology Program's Monograph on Health Effects of Low-Level Lead (NTP, 2012) that

found sufficient evidence of effects on cognitive measures and behavior at blood lead levels below 5 µg/dL, and the EPA's 2013 Integrated Science Assessment for Lead (EPA, 2013), which found clear evidence of cognitive function deficits at blood lead levels between 2 and 8 µg/dL.

Most recently, based on literature searches from 2013 to 2019, the ATSDR's 2020 Toxicological Profile for Lead (ATSDR, 2020) reviewed 694 epidemiological studies that evaluated the health effects of lead in all organ systems. This updated Toxicological Profile concluded that “[f]or the most studied endpoints (neurological, renal, cardiovascular, hematological, immunological, reproductive, and developmental), effects occur at the lowest PbBs (blood lead) studied ( $\leq 5$  µg/dL).” Some of the more recent studies included in the Toxicological Profile provide “supporting evidence that exposures to Pb may produce effects on cognitive function in populations whose PbBs are well below 5 µg/dL, and may extend to levels below **1 µg/dL** [emphasis added].”

If the blood lead level of concern is revised by the Agency to a value less than 10 µg/dL, the resulting residential soil lead cleanup level, that is based on potential health risks to a child receptor, would be lower than 400 ppm. **Should the residential soil lead policy change, a lower cleanup level may be necessary to be protective of human health.**