Letter Health Consultation

Public Health Evaluation of Surface Soil Data
at the Weirton BOP Implosion Site

WEIRTON BOP IMPLOSION RESIDENTIAL SOIL

WEIRTON CITY HANCOCK COUNTY, WEST VIRGINIA

December 29, 2021

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Community Health and Hazard Assessment
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Atlanta, Georgia

December 29, 2021

Deborah Lindsey
Environmental Protection Agency, Region III
1060 Chapline Street
Wheeling, West Virginia 26003

Dear Ms. Lindsey,

On May 29, 2020, the Environmental Protection Agency, Region III, requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct a public health evaluation of community exposures to contaminants in soil following the March 2019 implosion of the Weirton Steel Basic Oxygen Plant (BOP) in Weirton City, Hancock County, West Virginia. Residents in the community whose homes were in the path of the implosion were concerned about the dust created by the implosion. Though the property owner and demolition crew suggested that residents vacate their homes during the implosion, many residents remained in their homes and observed thick levels of dust in their community created from the implosion.

After the implosion, the dust was pervasive in outdoor air and on outdoor surfaces and seeped into indoor air within residents' homes and settled on indoor surfaces. Weirton residents were concerned about exposure to contaminants in airborne dust during the implosion and settled dust on surfaces and in soil after the implosion. This letter health consultation provides ATSDR's review of the environmental sampling information available to address the community's concerns.

The community had a local independent chemist sample settled surface dust on March 2019. Though the dust samples did show the presence of some metals, the dust sampling method was not consistent with EPA sampling methods. Given the difference in the sampling method, it is difficult to make conclusions about community member exposures from dust samples. In October 2019, the West Virginia DEP asked if EPA could conduct a removal site evaluation to evaluate the residential neighborhood for site contaminants from the implosion. Without a standard protocol for dust sampling, EPA's removal assessment used soil sampling instead of dust sampling.

EPA collected discrete surface soil samples at a 0-3 in. depth from a targeted residential area where the BOP implosion created a visible layer of dust and requested that ATSDR evaluate these surface soil data and from three background locations. The soil samples were taken from a combination of city-owned properties and residential properties that were vacant at the time of the assessment. Because occupied properties were believed to have been cleaned up after the implosion, the soil samples were taken from vacant areas as a surrogate for soil exposures in nearby occupied yards. The background locations are believed to not have been in the area impacted by the facility implosion (TechLaw 2020).

To address EPA's request to determine whether the potential contamination from the implosion had the potential to cause adverse health effects to residents, ATSDR searched for but could not find representative air quality data for immediately nearby and during the implosion event. The two closest National Ambient Air Quality Standards (NAAQS) particulate matter monitors in the area were located approximately three-fourths of a mile to the north and two miles to the south of the implosion site. Drone footage of the implosion showed that the dust plume settled to the east of the implosion site. As such, these NAAQS monitors were not identified as relevant for this assessment.

Further, West Virginia Department of Environmental Protection (WVDEP) reviewed data for these monitors and did not identify any exceedances of air quality standards (Weisenborn 2019).

In summary, based on our assessment of surface soil data from the targeted residential area directly impacted by the dense implosion dust plume (east of the facility), ATSDR concludes that children playing or recreating in bare soil could incidentally ingest lead in soil that could contribute to their overall lead burden and blood lead level. In addition, one background sample and samples from 8 locations in the targeted residential area contained arsenic above ATSDR's screening value, but upon further evaluation ATSDR determined that arsenic at all locations were at concentrations unlikely to cause non-cancer harmful health effects. Exposure to arsenic at levels detected in background and residential areas may result in a low increase in lifetime cancer risk, but this increase is not at a level of public health concern. All other contaminants in the target residential area were below health-based screening levels or were common soil components and essential nutrients (e.g., iron, calcium).

Though lead concentrations are at levels for concern at some locations in soil near the site, there are important limitations to the soil information reviewed and its relation to the BOP implosion. The available soil data are from samples collected several months following the BOP implosion, and environmental conditions may have caused the dust to unevenly disperse and/or migrate from the initial deposition area. Further, results from a single soil sampling event and limited timeframe only provides an estimate of the implosion's impact and soil concentrations under a given set of conditions for a specific time. It may not represent actual soil contaminant exposure concentrations over time. Moreover, we do not know if there are differences in concentrations from properties that were sampled (unoccupied residential properties and city-owned recreational properties in the targeted residential area) compared to currently occupied properties that were not sampled in this same residential area. The conclusions in this document specifically apply to recreational exposures and residential exposures. Lastly, there is uncertainty as to whether the surface soil contaminant concentrations were lower before the implosion or have changed significantly since the implosion as a result of weathering and erosion.

The most impactful step to reduce concerns and exposures in future situations is to ensure that appropriate dust control measures are implemented locally during implosion/demolition events. ATSDR also recommends that responsible parties and/or local and/or state agencies ensure that appropriate oversight and controls at these events are implemented. Further, when environmental exposure concerns are likely, ATSDR recommends that responsible parties and/or local, state, or federal agencies consider conducting fence line air monitoring during future implosions or other demolition activities that are expected to create excessive amounts of dust. After an implosion/demolition event in a residential area that is not appropriately controlled, authorities could also consider sampling settled dust on indoor and outdoor surfaces immediately after the event. If more information is desired about specific exposures to metals in soil in the Weirton implosion area, ATSDR recommends that responsible parties and/or local, state, or federal environmental agencies consider additional sampling in occupied residential yards for lead content analysis and further evaluation of soil in the playground area. Further details on ATSDR's evaluation, conclusions, and recommendations are provided in the remainder of this document.

Background

Weirton Basic Oxygen Plant (BOP) implosion site is located on the property that was originally Weirton Steel, which operated since the early 20th century. The plant combined basic oxygen steel production, vacuum degreasing, and continuous casting within a 20-story high, 250,000 square foot plant. Its development led to a population increase in the City of Weirton with a population of 28,000 at its peak. Currently, approximately 7,400 people live within one mile of the site, while the population of the entire town of Weirton is approximately 18,500. Including the rail and staging yard, the facility covered more than six acres. ArcelorMittal acquired the property in 2005, at which time the steel production was phased out in favor of steel finishing. With no need for the Basic Oxygen Plant, ArcelorMittal began the demolition process for the building. Asbestos-containing material (ACM) was removed prior to demolition. On March 9, 2019, the final demolition process of imploding the structure caused dust to collect on and around nearby residences within the vicinity of the implosion. The dust raised concerns for citizens due to the potential presence of contaminants, including heavy metals and asbestos. An independent chemist hired by a local law firm collected a dust sample, had the samples analyzed at a laboratory, and identified contaminants of concern.

In February 2020, West Virginia Department of Environmental Protection (WV DEP) asked EPA's Removal Program to sample and analyze soil from adjoining undeveloped and vacant properties to determine the impact of the dust that settled after the implosion in areas surrounding the site. In May 2020, EPA requested that ATSDR assist in evaluating community exposures.

Shallow surface soil samples were collected from 0-3 inches below ground surface from properties that had not undergone a cleanup since the implosion. These samples were used to determine whether the implosion deposited contaminants at levels of public health concern (TechLaw 2020).

Soil Sampling Data

EPA provided ATSDR with vacant residential and city-owned surface soil sampling data collected as part of their removal site assessment. A removal site assessment is conducted to determine whether human health or environmental risks warrant a time-critical removal action by the EPA. Seventeen locations were sampled in the targeted residential area and two duplicate samples. Nine of the soil sample locations were taken from vacant residential properties, and five locations were from city-owned property. These 14 samples comprise the data set for the residential area impacted by the dense implosion dust plume, generally to the east of the facility. Each discrete soil sample was taken from an individual property parcel located near occupied residences. Soil samples were mostly moist with silt and clay present and were placed in aluminum pans and thoroughly homogenized upon sampling. Three locations were background soil samples (i.e., to the west, and upwind of the implosion dust plume). The terrain of these sampling locations varied in elevation, soil cover/vegetation, and soil type, but most locations had at least partial grass or vegetation cover (TechLaw 2020).

Data Screening and Evaluation

The soil sample results were screened against health-based comparison values (CVs). The only contaminant that exceeded ATSDR's CV was arsenic. Additionally, the hexavalent chromium CV is 0.22 milligrams per kilogram (mg/kg), which is lower than the laboratory detection analytical limit for hexavalent chromium of 0.82 mg/kg. Because exposure to hexavalent chromium at the detection limit would be a very low risk, ATSDR did not do any further analysis on this contaminant. No ATSDR CV exists for manganese, but one background location was detected at 5510 mg/kg which is above the EPA Regional Screening Level (RSL) for residential soil of 5500 mg/kg. This location was in a grassy area of the parking lot for the Community Events Center in Weirton. As this area is neither residential nor recreational, we would not expect recurring exposures to manganese at this concentration and did not further assess manganese.

Table 1. Soil contaminants retained for further evaluation, Weirton City, WV

Analyte Name	Maximum (mg/kg)	Recommended Soil CV (mg/kg)	CV Source
Arsenic	43.9 (background) 20.3 (targeted area)	16	Chronic EMEG Child/Intermediate RMEG Child
Hexavalent Chromium	<0.82	0.22	CREG
Iron	64,700	40,000	Institute of Medicine Upper Limit
Lead	485	N/A	N/A
Manganese	5,510	5,500	EPA Regional Screening Level (RSL)

<X = Analyte was detected below the laboratory analytical limit
EMEG – environmental media evaluation guide CREG – cancer risk evaluation guide RMEG – remedial media evaluation guide
‡No ATSDR health-based comparison value for lead in soil exists because there is no clear threshold for some of the more sensitive health effects from lead exposure. EPA RSL for residential soil lead is 400 mg/kg.

Arsenic exceeded ATSDR's CV at one of the background locations, which included city-owned properties such as city parks and were assumed to be used for recreation. Though the maximum concentration in the targeted residential area was much lower than the maximum background location, the residential area still had exceedances of the ATSDR recommended CV for arsenic. We therefore assessed arsenic exposure in both a recreational scenario for the maximum background location and a residential scenario for the maximum targeted residential area. Lead exceeded the RSL for residential soil (400 mg/kg) in one sample from the plume-impacted area at 485 mg/kg (EPA 2020). Further, ATSDR does not have a CV for lead, so we selected lead for further evaluation. EPA also sampled for asbestos fibers, though none of the samples had asbestos fibers above the analytical limit of detection, so asbestos was not retained for further evaluation. ATSDR does not have a screening value for iron, but it was detected above the Institute of Medicine Upper Limit for iron (Institute of Medicine 2019). All other metals detected in soil were found to be below the applicable CV (see Appendix C, Table 2) and likely would not result in health effects.

The maximum arsenic concentration at the site was found at one of the background sample locations, SS-19, with a concentration of 43.9 mg/kg. The maximum arsenic concentration within the targeted residential area was 20.3 mg/kg. These locations had arsenic concentrations that were above the CV for arsenic of 16 mg/kg (children's chronic Environmental Media Evaluation Guideline or EMEG) and were used as a "worse-case" scenario. The children's chronic EMEG is the concentration of arsenic that is not expected to result in adverse noncarcinogenic health effects from daily exposure of one year or more. The EMEG is based on ATSDR's Minimal Risk Level (MRL) (ATSDR 2007). These health guidelines are derived from data in epidemiologic and toxicologic literature and include uncertainty factors and indicate whether further evaluation is necessary.

Because arsenic exposure may increase children's risk for certain health outcomes, such as skin changes and increased cancer risk, it was selected as a contaminant of concern to evaluate the site-specific daily exposure doses. ATSDR Exposure Dose Guidance was used to calculate exposure doses using standard default exposure assumptions for soil ingestion (ATSDR 2018).

Though there is no ATSDR screening value for lead, the EPA Regional Screening Level (RSL) for lead in soil is 400 mg/kg. As there is no safe level of lead in blood, it is important to prevent exposure to lead in soil due to the potential cumulative effect of multiple sources of lead exposure. Because of this, the health implications of lead exposures are also further discussed below.

Discussion

Exposure Pathway Evaluation

Exposure pathways are categorized as completed, potential, or eliminated based on five pathway elements as listed in Table 1; the category may differ for past, present, or future conditions. A completed exposure pathway is one in which all five elements are present. In a potential exposure pathway, at least one of the pathways elements is uncertain. A pathway is eliminated when one or more elements are missing or prevented and are unlikely to be present (ATSDR 2005). ATSDR identified a completed exposure pathway via ingestion of contaminants present in soil based on past and present exposure conditions. The completed exposure pathways are summarized in Table 2 below.

The source of the contaminants cannot be definitively identified and may be because of the BOP implosion, naturally occurring soil components, or other anthropogenic sources. Because heavy metal concentrations, such as those for arsenic and lead, remain consistent in surface soils over time, they will remain at similar levels unless the soil is remediated.

Table 2. Exposure Pathways and Pathway Elements for Contaminants in Soil

Pathway	Element 1: Source	Element 2: Environmental Media	Element 3: Point of Exposure	Element 4: Exposure Route	Element 5: Exposed Population
Targeted residential area	BOP Implosion or other source	Soil	Residential – gardening, playing, etc.	Incidental ingestion	Children and adults playing, gardening, or picnicking in the targeted residential area
Background locations	Naturally occurring/ background or unknown	Soil	Recreational – playing, picnicking, etc.	Incidental ingestion	Children and adults playing or picnicking in public areas

One background location with elevated arsenic levels is owned by the City of Weirton. The land is currently used as a park, with a picnic area to the south of the park, a basketball court to the north of the park, and a playground in between the picnic area and basketball court. The soil sample was taken from a grassy area north of the basketball court, which was on the opposite side of the park from the playground and picnic area. Because this area has grass cover, the potential for exposure to arsenic is lower than if the area were bare soil (TechLaw 2020). This location was likely not affected by the implosion, but current and future recreational exposures remain a possibility.

The soil sampling location within the targeted residential area with the maximum arsenic concentration was in a vacant residential lot. This lot is located between occupied residences on May Street and Kessel Street and has grassy cover. The sampling location is within the estimated implosion impact area, where there are several residences, municipal buildings, churches, and other community structures and areas (TechLaw 2020).

The soil sample with elevated lead content (in the plume-impacted area east of the BOP plant) is a vacant residential lot. Though the lot is currently unoccupied, the land is adjacent to a basketball court and may be used for recreation. Children and adults may be exposed through playing or picnicking in bare soil areas. Soil particles on hands may be ingested through eating or hand-to-mouth actions if proper handwashing isn't followed after coming into contact with the soil. This area also has grass cover which makes the potential for exposure to lead in soil much lower than if the area were bare soil (TechLaw 2020). This location, as well as others in the targeted residential area, may have been affected by the dust plume or other sources of lead. Because these locations were sampled as surrogates for occupied properties, it is possible that nearby properties may have similar levels of contamination and that residents were exposed in the past. Further, if residents move onto currently vacant properties, there is the potential for future residential exposure.

Health Implications

Through the previously described screening process, ATSDR identified arsenic and lead as contaminants of concern. ATSDR also retained iron, hexavalent chromium, and manganese; however hexavalent chromium and manganese were not detected at high levels in frequently accessed areas and were not considered further. Though iron was detected above an external CV, the Institute of Medicine Upper Limit, it only poses a health risk to certain populations. There is a health condition for which too much iron can be dangerous. Iron overload, or hemochromatosis, occurs when the body absorbs too much iron from foods (and other sources such as vitamins containing iron). Although hemochromatosis can have other causes, the disease is most often characterized as a genetic defect in the United States. The genetic defect is inherited from both parents and is present at birth, but symptoms rarely appear before adulthood. The iron overload associated with hemochromatosis can be detected through two blood tests. Treatment consists of periodically taking blood from the arm, similar to blood donation (CDC 2008). Iron levels that are dangerous to adults and children with hemochromatosis are specific to the individual. As such, if residents have hemochromatosis, they should consult with their physician on iron exposure in soil.

Arsenic

Though there were several locations in the area affected by the implosion that were above the ATSDR screening value for arsenic, we assessed health impacts using the site maximum (background location) in a recreational exposure scenario and the maximum within the targeted residential area in a residential exposure scenario. The arsenic level at the location of concern discussed below is a worse-case scenario for a likely non-site related recreational exposure. Arsenic is a naturally occurring element that is commonly found in soil in either an organic or a more harmful inorganic form of the element. The International Agency for Research on Cancer (IARC) and the EPA have determined that inorganic arsenic is carcinogenic to humans (ATSDR 2007). On average, naturally occurring arsenic concentrations in soil within the Eastern U.S. range from 0.1–73 mg/kg with a mean of 7.4 mg/kg, though much higher levels may occur in mining areas, at waste sites, near high geological deposits of arsenic-rich minerals, or from arsenic-based pesticide applications (USGS 1984, ATSDR 2007a).

Arsenic Evaluation for Background/Recreational Location and Scenario

Table 3. Calculated Arsenic Exposure Doses, Hazard Quotient, and Cancer Risk Estimates for a Recreational Scenario at Soil Sample Location SS-19 (Maximum level detected)

Age Group	Chronic Exposure Dose (ED) – CTE mg/kg/day	Chronic Exposure Dose (ED) – RME mg/kg/day	Hazard Quotient (ED/cMRL) – RME	Excess Cancer Risk (RME)
Birth to 1 y.	1.1×10^{-4}	2.5×10^{-4}	0.83	N/A
1 – 2 y.	1.1×10^{-4}	2.3×10^{-4}	0.75	N/A
2 to <6 y.	5.7×10^{-5}	1.5×10^{-4}	0.50	N/A
6 to <11 y.	3.6×10^{-5}	8.7×10^{-4}	0.29	N/A
11 to <16 y.	1.7×10^{-5}	3.1×10^{-5}	0.10	N/A
16 to <21 y.	1.5×10^{-5}	2.6×10^{-5}	0.087	N/A
Birth to 21 y.	N/A	N/A	N/A	3.5×10^{-5}
Adult	7.4×10^{-6}	1.8×10^{-5}	0.058	2.7×10^{-5}

Note: Chronic oral arsenic MRL = 3.0×10^{-4},
ED = Exposure Dose; CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure; cMRL = Chronic Minimum Risk Level
mg/kg/day = milligrams of contaminant per kilogram of soil per day
y. = years of age; [a] = Cancer risk was calculated using EPA's Cancer Slope Factor of 1.5 mg/kg/day
Site-specific assumptions: 4 days/week exposure, 40 weeks/year, 78 years of exposure for adult scenario

Using the maximum identified concentration of arsenic, doses were calculated in the Public Health Assessment Site Tool (PHAST) for a typical, or "central tendency" (CTE), exposure scenario as well as a "reasonable maximum exposure" (RME) scenario for soil ingestion. Instead of default scenario assumptions, we calculated doses by estimating four days per week of exposure, 40 weeks per year, and over 78 years for adults to account for irregular recreation frequency and seasonality. Exposure doses and associated health outcomes would differ if the scenario were residential and residents exposed on a daily basis. For this recreational scenario, we compared the estimated daily CTE and RME doses to the ATSDR Minimum Risk Level (MRL) of 0.0003 mg/kg/day. The MRL is based on the no observed adverse effect level (NOAEL) of 0.0008 mg/kg/day where dermal changes (hyperpigmentation and hyperkeratosis) were not observed (ATSDR 2007). A lowest observed adverse effect level (LOAEL) of 0.014 mg/kg/day was also observed in the same study. The site-specific exposure doses, hazard quotients, and excess cancer risks are summarized in Table 3 above.

Noncancerous health effects are evaluated based on the value of the hazard quotient (HQ). The HQ for a chemical is the ratio of the estimated exposure dose to the MRL, RfD, or other health guidance value. The higher the exposure dose is above the health guideline, the greater the chance for noncancerous health effects. If the HQ is less than 1.0, noncancerous harmful effects are unlikely to occur. Using PHAST to calculate the HQ for arsenic, the RME and CTE HQ did not exceed 1.0 for any age group. In summary, it is unlikely that children or adults would experience non-cancer health effects from exposure to arsenic in soil at the site.

ATSDR calculated the cancer risk estimates within PHAST using the EPA's arsenic oral cancer slope factor (CSF) of 1.5 $(mg/kg/day)^{-1}$. We assumed a worst-case scenario in determining adult cancer risks, with an estimated 78 years of exposure. As such, we estimated an exposure duration based on an average life span in the U.S. Using the maximum level of arsenic detected, cancer risks were determined to be 3.5×10^{-5} and 2.6×10^{-5} for children's (birth to 21 years) and adults' RME, respectively. These risks indicate that exposure to arsenic would cause 3 excess cancers per 100,000 people. The cancer risk estimates show that over a lifetime, exposure to arsenic-contaminated soil at this location may cause low increased cancer risk. ATSDR only considers a cancer risk to be at a level of concern if it exceeds 1 in 10,000 individuals. Therefore, this slight increase in cancer risk is not at a level of public health concern, even in this worst-case scenario. Actual exposures may be even lower considering that Weirton adults are not likely to be exposed at the same park in the same way throughout their entire lives.

Arsenic Evaluation for Targeted Residential Area Scenario

Table 4. Calculated Arsenic Exposure Doses, Hazard Quotient, and Cancer Risk Estimates for a Residential Scenario at Soil Sample Location SS-03 (Maximum level detected)

Age Group	Chronic Exposure Dose (ED) – CTE mg/kg/day	Chronic Exposure Dose (ED) – RME mg/kg/day	Hazard Quotient (ED/cMRL) – RME	Excess Cancer Risk (RME)
Birth to 1 y.	1.1×10^{-4}	2.6×10^{-4}	0.87	N/A
1 – 2 y.	1.2×10^{-4}	2.4×10^{-4}	0.79	N/A
2 to <6 y.	6.0×10^{-5}	1.6×10^{-4}	0.53	N/A
6 to <11 y.	3.8×10^{-5}	9.1×10^{-4}	0.30	N/A
11 to <16 y.	1.8×10^{-5}	3.3×10^{-5}	0.11	N/A
16 to <21 y.	1.5×10^{-5}	2.7×10^{-5}	0.091	N/A
Birth to 21 y.	N/A	N/A	N/A	3.6×10^{-5}
Adult	7.8×10^{-6}	1.8×10^{-5}	0.061	2.8×10^{-5}

Note: Chronic oral arsenic MRL = 3.0×10^{-4},
ED = Exposure Dose; CTE = Central Tendency Exposure, RME = Reasonable Maximum Exposure; cMRL = Chronic Minimum Risk Level
mg/kg/day = milligrams of contaminant per kilogram of soil per day
y. = years of age; [a] = Cancer risk was calculated using EPA's Cancer Slope Factor of 1.5 mg/kg/day
Site-specific assumptions: 4 days/week exposure, 40 weeks/year, 78 years of exposure for adult scenario

We calculated residential doses using a default scenario of assuming 7 days per week of exposure, 52 weeks per year, and over 78 years for adults. For the residential scenario, we again compared the estimated daily CTE and RME doses to the ATSDR MRL of 0.0003 mg/kg/day. Using PHAST to calculate the HQ for the residential scenario, the RME and CTE HQ did not exceed 1.0 for any age group. In summary, it is unlikely that children or adults would experience non-cancer health effects from residential exposure to arsenic in soil in the residential area.

ATSDR also calculated the cancer risk estimates for a residential scenario. Using the maximum level of arsenic detected in the residential area, cancer risks were determined to be 3.6×10^{-5} and 2.8×10^{-5} for children's (birth to 21 years) and adults' RME, respectively. The cancer risk estimates show that over a lifetime, exposure to arsenic-contaminated soil at this location may cause low increased cancer risk. However, this slight increase in cancer risk is below 1×10^{-4}, and thus is not at a level of public health concern even in this worst-case scenario. Actual exposures may be even lower considering that residents may move throughout the course of their lifetime. The site-specific exposure doses, hazard quotients, and excess cancer risks are summarized in Table 4 above.

Lead

Lead is a naturally occurring element, but it is often found in soil at elevated levels because of the historic use of leaded gasoline and lead paint that deposited lead into the soil around roadways and house driplines. Because lead paint was federally banned in 1978, older homes are much more likely to have lead paint with a higher potential for lead in soil near the home. In Weirton, approximately 30% of the housing stock was built before 1950. Lead exposure also tends to occur more frequently in rental properties. Weirton has approximately 30% of total homes as rental properties. Families with lower income, minority populations, and immigrants have increased risk for lead exposure. The community is largely non-Hispanic white, U.S. citizens, and of average income for West Virginia (U.S. Census Bureau 2019). These factors may put Weirton residents at an increased risk for lead exposure.

Lead has no nutritional benefits for humans and causes adverse health effects on the nervous system, especially in developing children. The developing fetus can also be exposed to lead if the pregnant woman has lead in her blood during pregnancy. Prenatal lead exposure can contribute to premature births, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children. Young children can also be exposed to lead through their mother's breast milk if the mother has an elevated blood-lead level (ATSDR 2007a). Relatively low levels of lead exposure have also been shown to lower the intelligence quotient (IQ) and the ability to pay attention (Lanphear BP et al. 2005).

No safe Blood Lead Level (BLL) exists; even low levels cause harm. In 2021, CDC updated the Blood Lead Reference Value (BLRV) to 3.5 µg/dL. (Ruckart et. al, 2021). This value identifies children with blood lead levels that are higher than most children's levels and is based on the 97.5th percentile of the blood lead values among U.S. children ages 1-5 years from 2015-2016 and 2017-2018 National Health and Nutrition Examination Survey (NHANES) cycles. Children with blood lead levels at or above the BLRV represent those at the top 2.5% with the highest blood lead levels. (CDC 2012). The National Institute for Occupational Safety and Health (NIOSH) also uses 5 µg/dL as the blood lead reference level for adults (NIOSH 2015).

The detected lead levels at one location sampled (P-04) was 485 mg/kg, which exceeds the EPA residential soil RSL of 400 mg/kg. Further, three other locations (P-02, P03, and P-10) exceeded 200 mg/kg – the soil level at which the EPA IEUBK model predicts a blood lead level of 5 µg/dL (EPA 2021). The concentration of lead at other locations were below 200 mg/kg but above the average lead soil levels in West Virginia of 31.4 (EPA 2012). Though locations other than P-04 were below the EPA RSL of 400 mg/kg, it is important to emphasize that there is no safe level of lead in blood. Soil containing lead concentrations below 400 mg/kg can still contribute to a child's blood lead level, and soil lead levels above 200 mg/kg may result in blood lead levels above 5 µg/dL. As such, children playing or recreating in bare soil areas in Weirton could incidentally ingest lead in soil that could contribute to their overall lead burden and blood lead level.

Limitations

There are some important limitations to ATSDR's evaluation:

- The soil samples were taken almost a year after the implosion event. Though the areas sampled were not remediated and were the best available proxy for actual exposure, they were still susceptible to natural weathering. Because sampling was not conducted soon after the dust settled on the targeted properties, it is unknown and possible that weathering and erosion may have dispersed the dust resulting in lower concentrations at the time of sampling.
- The soil samples were taken from unoccupied residential or recreational, city-owned properties, and ATSDR used these properties as a proxy for current residential exposure. We do not know if there are differences in concentrations between these proxy properties and the occupied residential properties.
- Only one soil sample was collected per land parcel, so soil variability within each parcel could not be captured.

- The soil sample with the highest arsenic level was located at a "background" location upwind of the BOP implosion dust plume migration path. The source of this arsenic is not known.
- It is not known if the BOP implosion dust plume caused enough contamination of residence's indoor areas to exceed concentrations of health concern. Indoor dust levels were not measured for implosion dust contaminants in this community following the implosion.
- Children living in housing built before 1978 and/or are enrolled in Medicaid may be at increased risk for lead exposure and are required to be tested at ages 12 and 24 months if they have not previously been screened (Ruckart et. al 2021). Further, lead poisoning occurs on an individual basis. ATSDR cannot rule out the possibility for lead exposure from air, water, and dust to co-occur with exposure to lead in soil and contribute to an increased blood lead level.

<u>Conclusions</u>

Based on the available surface soil sampling data, ATSDR concludes that:

- Exposure to arsenic in soil at the maximum concentration detected in both the targeted residential area and the background recreational areas is unlikely to cause harmful non-cancer health effects. The low increased lifetime cancer risk is not at a level of public health concern. The location that showed an elevated level of arsenic in surface soil was at a "background" location and not downwind of the implosion dust plume's path.
    - Children and adults recreating in soil at the public park may be exposed to doses of arsenic that are below the MRL, which indicates that harmful health effects are not expected.
- Children playing or recreating in bare soil at locations in the targeted residential area could incidentally ingest lead in soil that could contribute to their overall lead burden and blood lead level.
    - Lead was elevated above background levels in West Virginia (EPA 2010) at several locations sampled within the area of concern; one of which exceeded the Regional Screening Level and three other locations exceeded the IEUBK model value of 200 mg/kg. The IEUBK model predicts that exposure to exposure to lead in soil over a concentration of 200 mg/kg may result in a blood lead level exceeding the federal Blood Lead Reference Value when other lead exposures are at IEUBK default levels. However, the targeted sampling area did not have consistently elevated lead levels. It is still important to reduce the overall lead exposure burden, including in soil. Children who come in repeated contact with lead in soil, especially when cumulatively exposed to lead in other sources (e.g., paint or water), are at greater risk for adverse health effects (slower growth and development, hearing damage, and attention and learning problems). Pregnant women exposed to lead are at higher risk for miscarriage, and the developing fetus is at risk for premature birth, low birth weight, learning and behavior problems, and damage to their developing brains, kidneys, and nervous system.
- Residents recreating in the soil who have hemochromatosis may experience adverse health effects from exposure to iron and should discuss exposures with their doctor.

Recommendations

If more information is desired about specific exposures to metals in soil in the Weirton implosion area, ATSDR recommends that responsible parties and/or local, state, or federal environmental agencies:

- Consider additional sampling in occupied residential yards for lead content analysis.
- Consider further evaluation of soil in the playground area.

ATSDR emphasizes that the most impactful step to reduce concerns and exposures in future situations is to ensure that appropriate dust control measures are implemented locally during implosion/demolition events. ATSDR recommends that responsible parties and/or local and/or state agencies ensure that appropriate oversight and controls at these events is implemented. For similar events in the future that may create excessive amounts of dust, ATSDR recommends that responsible parties and/or local, state, or federal agencies:

- Set up fence line and residential neighborhood air monitoring equipment before a planned event to ensure that any dust created during an implosion or other demolition does not exceed environmental or health-based standards.
- Consider conducting interior dust sampling using EPA protocols for any similar events in the future immediately after an implosion or other demolition that creates significant dust indoors.

ATSDR recommends residents in the community, especially frequented locations where elevated arsenic and lead are present:

- When recreating:
    - Avoid playing in bare soil.
    - Watch children's hands carefully to prevent them from ingesting soil.
    - Frequently wash hands, toys, and pacifiers.
- If gardening in contaminated areas:
    - Consider building raised beds to fill with clean soil for growing food crops.
    - Consider covering contaminated soil with clean soil, mulch, or other materials.
- Ensure proper hygiene practices
    - Keep soil outdoors by using doormats, taking off shoes, and regular cleaning.
    - Reduce exposure from pets that go outside by maintaining proper pet hygiene.
    - Wear gloves or wash hands and other exposed skin after contacting soil.
- Replace air filters for indoor HVAC systems and consider changing more frequently.
- Take steps to reduce children's total lead exposure burden, including avoiding sources that contain lead such as lead-based paint; brass; lead-containing toys, candies, or tableware; traditional folk medicines; contaminated soil/dust; and lead from hobbies or jobs (e.g., stained glass, firearm ammunition, fishing weights, welding, and home renovation).
- Families concerned about their children's blood lead level can discuss more frequent or regular blood testing with their children's physician.
- If residents have hemochromatosis, they should consult with their physician on iron exposure from contaminated soil.

Thank you for allowing ATSDR this opportunity to provide EPA with this public health evaluation. We welcome opportunities to further discuss the concerns about exposures in this community. Please contact me if you would like to discuss this further.

Sincerely,

Emily Adler
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ATSDR Region 3
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Philadelphia, PA, 19103
215-814-2927
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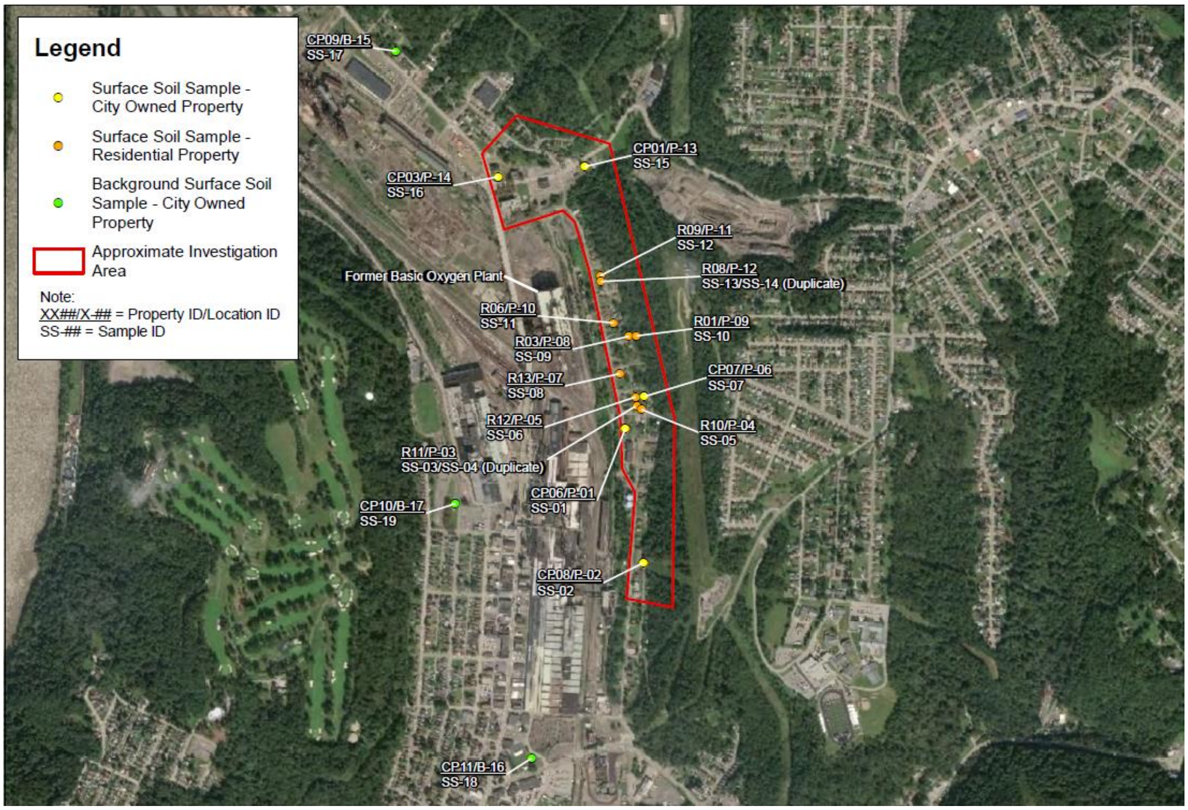
Appendices

Appendix A: Maps of area affected by Weirton BOP implosion



Map of Surface Soil Sample Locations

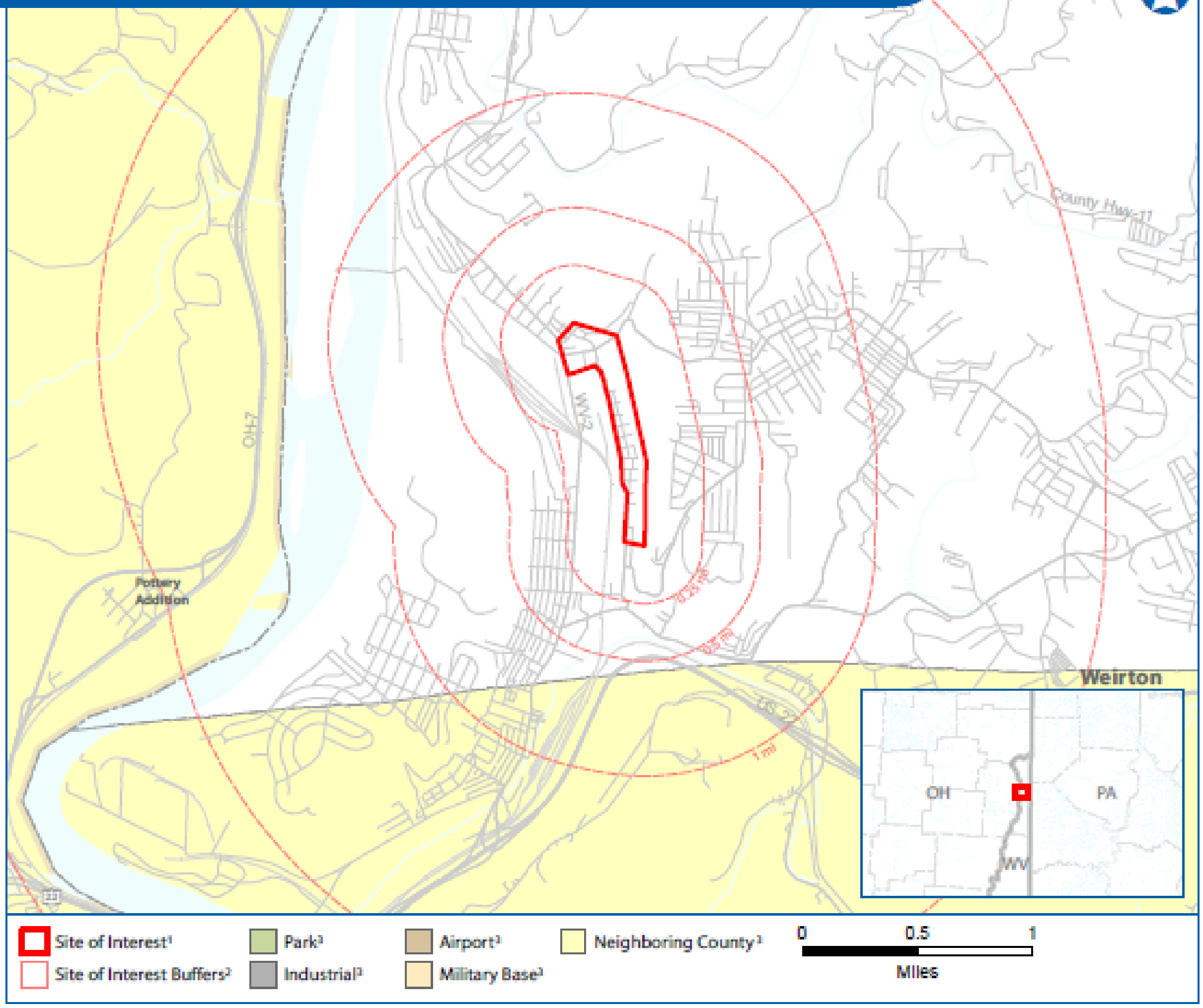
Weirton BOP Implosion Site

Weirton, Hancock County, WV

EPA FACILITY ID NOT AVAILABLE

INTRODUCTORY MAP SERIES

SITE AND DEMOGRAPHIC SNAPSHOT



Demographic Statistics[4,5]

Within 1 Miles buffer of site boundary

Measure	2000	2010	Change	Measure	2000	2010	Change
Total Population	7,776	7,379	-5%	Two or More Races	91	181	+98%
White Alone	7,011	6,646	-5%	Hispanic or Latino[6]	62	79	+27%
Black Alone	625	519	-16%	Children Aged 6 and Younger	627	601	-4%
Am. Indian & AK Native Alone	5	4	-20%	Adults Aged 65 and Older	1,510	1,254	-16%
Asian Alone	26	12	-53%	Females Aged 15 to 44	1,560	1,310	-16%
Native Hawaiian & Other Pacific Islander Alone	0	2	N/A	Housing Units	3,716	3,648	-1%
Some Other Race Alone	16	13	-18%	Housing Units Pre 1950	2,440	1,030	-57%

Data Sources: [1]EPA Report. [2]ATSDR GRASP. [3]TomTom 2019Q1. [4]US Census 2010.
Notes: [5]Calculated using area-proportion spatial analysis method. [6]Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: NAD 1983 StatePlane West Virginia North FIPS 4701 Feet.

GRASP

Agency for Toxic Substances and Disease Registry

Division of Toxicology and Human Health Sciences

ATSDR

FINAL - FOR PUBLIC RELEASE

Map of site boundary and demographics summary

Appendix B: Equations

Exposure Dose Equation for incidental ingestion and dermal contact

Exposure Dose Equation for Ingestion

ED = (C x IR x EF x CF x AF)/BW

ED = Exposure dose (mg/kg/day)

C = Contaminant Concentration (mg/kg)

IR = Ingestion Rate of contaminated soil (100 mg/day was used)

EF = Exposure Factor (1)

CF = Conversion Factor (10^{-6} kg/mg)

AF = Bioavailability Factor 0.6 for arsenic

BW = Body Weight (80 kg)

Days per week exposed = 4 days/week

Weeks per year exposed = 40 weeks/year

Exposure Dose Equation for Dermal Absorption

ED = (C x A x AF x EF x CF)/BW

ED = Exposure Dose (mg/kg/day)

C = Contaminant Concentration (mg/kg)

A = Total soil adhered (mg) = 326 mg

AF = Absorption Factor of 0.03 for arsenic

EF = Exposure Factor (1)

CF = Conversion Factor (10^{-6} kg/mg)

BW = Body Weight (80 kg)

Calculation for the evaluation of excess cancer risk

CR = ED x CSF x Estimated exposure years/78 years

CR = Cancer Risk; ED = Exposure Dose; CSF = Cancer Slope Factor:1.5 $(mg/kg/day)^{-1}$ for arsenic. Estimated exposure years for adults is 78 years and for children is 21 years.

Appendix C: Tables

Table C-1. Trespasser/Recreational: Site-specific combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 44 mg/kg along with non-cancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration for Cancer (yrs)
Birth to < 1 year	0.00011	0.36	-	0.00025	0.83	-	1
1 to < 2 years	0.00011	0.38	-	0.00023	0.75	-	1
2 to < 6 years	5.70E-05	0.19	-	0.00015	0.50	-	4
6 to < 11 years	3.6E-05	0.12	-	8.7E-05	0.29	-	5
11 to < 16 years	1.7E-05	0.057	-	3.1E-05	0.10	-	5
16 to < 21 years	1.5E-05	0.049	-	2.6E-05	0.087	-	5
Total Child	-	-	1.5E-5 ‡	-	-	3.5E-5 ‡	21
Adult	7.4E-06	0.025	1.1E-5 ‡	1.8E-05	0.058	2.67E-5 ‡	78

Source: [TechLaw 2020]

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

* The calculations in this table were generated using ATSDR's PHAST v1.7.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0003 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 1.5 $(mg/kg/day)^{-1}$. Default assumptions were used for most parameters. Exposure factors were adjusted to 4 days per week and 40 weeks per year and for a U.S. life expectancy of 78 years.

† A shaded cell indicates the hazard quotient exceeds the non-cancer health guideline, which ATSDR evaluates further.

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

Appendix C: Tables

Table C-2. Residential: Site-specific combined ingestion and dermal exposure doses for chronic exposure to arsenic in soil at 20 mg/kg along with non-cancer hazard quotients and cancer risk estimates*

PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	CTE Cancer Risk	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient	RME Cancer Risk	Exposure Duration for Cancer (yrs)
Birth to < 1 year	0.00011	0.38	-	0.00026	0.87	-	1
1 to < 2 years	0.00012	0.40	-	0.00024	0.79	-	1
2 to < 6 years	6.0E-05	0.20	-	0.00016	0.53	-	4
6 to < 11 years	3.8E-05	0.13	-	9.1E-05	0.30	-	5
11 to < 16 years	1.8E-05	0.060	-	3.3E-05	0.11	-	5
16 to < 21 years	1.5E-05	0.052	-	2.7E-05	0.091	-	5
Total Child	-	-	1.6E-5 ‡	-	-	3.6E-5 ‡	21
Adult	7.8E-06	0.026	1.2E-5 ‡	1.8E-05	0.061	2.8E-5 ‡	78

Source: [TechLaw 2020]
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
* The calculations in this table were generated using ATSDR's PHAST v1.7.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0003 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 1.5 $(mg/kg/day)^{-1}$. Default assumptions were used for most parameters. Exposure factors were set to default (7 days/week, 52 weeks/year) and for a U.S. life expectancy of 78 years.
† A shaded cell indicates the hazard quotient exceeds the non-cancer health guideline, which ATSDR evaluates further.
‡ A shaded cell indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

Table C-3. Screening Summary for Contaminants Detected in Soil or Sediment, Weirton BOP Implosion, February 2020

Analyte Name	# Detects / # Results	Maximum (mg/kg or % for asbestos)	Recommended Soil CV (mg/kg)	CV Source	Retain for Further Evaluation?
Aluminum	17 / 17	17,600	52,000	Chronic EMEG Child/Intermediate EMEG Child	No
Antimony	1 / 17	1.3	21	RMEG Child	No
Arsenic	17 / 17	**43.9** (background) **20.3** (targeted area)	16	Chronic EMEG Child/Intermediate RMEG Child	**Yes**
Barium	17 / 17	285	10,000	Chronic EMEG Child/Intermediate EMEG Child/RMEG Child	No
Beryllium	15 / 17	3	100	Chronic EMEG Child/RMEG Child	No
Cadmium	11 / 17	2.5	5.2	Chronic EMEG Child	No
Calcium	17 / 17	44,500	N/A	N/A	No***
Chromium‡‡ (total)	17 / 17	218	78,000	Chronic RMEG Child	No
Cobalt	17 / 17	13.3	520	Intermediate EMEG Child	No
Copper	17 / 17	210	520	Intermediate EMEG Child	No
Iron	17 / 17	**64,700**	40000	Institute of Medicine (IOM) Upper Limit	No**
Lead	17 / 17	485	N/A‡	N/A	**Yes‡**
Magnesium	17 / 17	16000	N/A	N/A	No***
Manganese	17 / 17	**5,510**	5500	EPA Residential Soil RSL	No
Nickel	17 / 17	33.5	1,000	RMEG Child	No
Potassium	17 / 17	3,190	N/A	N/A	No***
Selenium	0 / 17	<5.6	260	Chronic EMEG Child/RMEG Child	No
Silver	2 / 17	3	260	RMEG Child	No
Sodium	1 / 17	47.4	N/A	N/A	No***
Thallium	0 / 17	<4.0	N/A	N/A	No***
Vanadium	17 / 17	96.4	520	Intermediate EMEG Child	No
Zinc	17 / 17	3,010	16,000	Chronic EMEG Child/Intermediate EMEG Child/RMEG Child	No
Mercury	9 / 17	0.32	33	EPA Regional Screening Level (RSL)	No
Hexavalent Chromium	0 / 17	**<0.82**	0.22	CREG	**Yes**
Asbestos	0 / 17	0%	N/A	N/A	No

NOTE: Several contaminants were analyzed in soil or sediment and not detected.
**The suggested CV for iron is based on the Institute of Medicine Upper Limit; does not suggest adverse health effects
Bold = maximum detected value higher than recommended CV
CREG – cancer risk evaluation guide
*n/a = not tested or not reported
<X = Analyte was detected below the laboratory analytical limit
EMEG – environmental media evaluation guide
RMEG – remedial media evaluation guide
‡No ATSDR health-based comparison value for lead in soil exists because there is no clear threshold for some of the more sensitive health effects from lead exposure. EPA RSL for residential soil lead is 400 mg/kg.
‡‡ Total chromium result is likely from mostly trivalent chromium, thus the screening value for Chromium (III) used here.
***There are currently no CVs available for calcium, magnesium, potassium, sodium, and thallium. These minerals are considered essential nutrients for the human body and are not evaluated further in this assessment. and were present at or below background levels for the state of West Virginia [USGS, 2017]."

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