ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

REEDSVILLE SCATTERED FOUNDRY WASTE CERCLIS SITE
REEDSVILLE, PRESTON COUNTY, WEST VIRGINIA
EPA FACILITY ID: WVN000305655
SEPTEMBER 7, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
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 our 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.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment 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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PUBLIC HEALTH ASSESSMENT

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REEDSVILLE, PRESTON COUNTY, WEST VIRGINIA

EPA FACILITY ID: WVN000305655

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Table of Contents

Foreword ii
Summary and Statement of Issues 1
Background 2
  Site description and history 2
  Demographics 7
Community health concerns 7
Discussion 7
  Data review and selection of chemicals of concern 7
  Human exposure pathway analysis 17
  Exposure analysis 22
  Possible health consequences from chemical exposures at this site 23
Community health concerns 28
Evaluation of health outcome data 30
Child health considerations 30
Conclusions 31
Recommendations 32
Public health action plan 32
Authors, Technical Advisors 34
References 36
APPENDIX A 39
APPENDIX B 43
APPENDIX C 54
APPENDIX D 58
APPENDIX E 67

Foreword

This document summarizes public health concerns related to exposure to soils mixed with foundry sand from the former Reedsville Sterling Faucet plant. The document also reviews the potential for adverse health effects from formaldehyde and methanol air emissions in the Reedsville community.

A number of steps are necessary to complete this document:

Evaluating exposure: The West Virginia Department of Health and Human Resources (WVDHHR) starts by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is found on and off the site, and how people might be exposed to it. The WVDHHR typically does not collect environmental samples. We rely on information provided by the West Virginia Department of Environmental Protection (WVDEP), U.S. Environmental Protection Agency (EPA), other governmental agencies, businesses, and other sources of valid information.

Evaluating health effects: If there is evidence that people are being exposed – or could be exposed – to hazardous substances, WVDHHR scientists will take steps to determine whether exposures could be harmful to human health. The report focuses on the health impact on the community as a whole, also called public health. The evaluation is based on existing scientific information.

Developing recommendations: In this report the WVDHHR outlines its conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the WVDHHR at these sites is primarily advisory. For that reason, these reports will typically recommend actions to be taken by other agencies – including the WVDEP and the EPA.

Soliciting community input: The evaluation process is interactive. WVDHHR starts by soliciting and evaluating information from various governmental agencies, the organizations responsible for cleaning up sites, and the community surrounding the site. Any conclusions about the site are shared with groups and organizations that provided the information.

If you have questions or comments about this report, we encourage you to:

Write: Program Manager
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Summary and Statement of Issues

Incidental ingestion of surface soils contaminated with lead and copper from foundry sand is the primary exposure pathway at this site. The West Virginia Department of Health and Human Resources (WVDHHR) concludes the Reedsville Scattered Foundry site poses a **public health hazard** at three of the 18 areas at this site because of exposure of children to lead and copper in on-site soil and sediment. The public health assessment was performed at the request of the United States Environmental Protection Agency Region III site assessment section.

Lead in soil and sediment at *Area 1 Arthur Road duplex* could cause adverse health effects to young children (under 7) who live here and ingest soil when playing outside and from exposure to household dust inside the duplex. Possible health effects include subtle decreases in IQ, muscle weakness, and anemia. These effects may have happened in the past and may occur in the future under the same exposure conditions. Pica behavior (eating soil) in *Area 1 Arthur Road duplex* and *Area 15 Residential* soils may result in changes in the blood and subsequent adverse health effects.

Exposures to lead in soil, sediment, and surface water via incidental ingestion in *Areas 2-18* at this site were not determined high enough to raise the children's blood lead levels over the CDC level of concern, 10 µg/dL. However, subtle adverse health effects are believed possible at blood lead levels at or below 10 µg/dL, such as changes in brain function, cardiovascular system, blood system, and growth retardation.

Exposure to copper via incidental ingestion at *Area 1 Arthur Road duplex* and at *Area 3 Well house area* may have caused short term nausea, vomiting, abdominal pain, and diarrhea in children. Pica behavior in *Area 1 Arthur Road duplex* and *Area 15 Residential soil* may have similar adverse health effects. These adverse health effects may have occurred in the past, may be currently occurring, or may occur in the future. Copper and tin should be assessed in *Area 10 Former Sterling Faucet facility-foundry sand disposal area* to fill a data gap.

The exposure to lead from air-borne foundry sand particles cannot be assessed due to a lack of data. Many places where foundry sand is visible have no vegetation. There is a possibility that the wind might move lead-containing particles into the air. Foundry sand removal is scheduled at *Area 10 Former Sterling Faucet facility-foundry sand disposal area*. No other removal activities are scheduled.

Formaldehyde and methanol exposures were evaluated due to community concerns about emissions from a manufacturing facility. Several formaldehyde sources are in the area and exposures to the community cannot be attributed to any one source. Exposure to formaldehyde in air at this site may cause eye, nose, and throat irritation and may trigger asthma attacks in sensitive people. Nose and upper throat (nasopharyngeal) cancers may develop from exposures to formaldehyde. These health effects may have occurred in the past, may be occurring in the present, and the future.

Background

Site description and history

Reedsville Scattered Foundry Waste Site, a/k/a Sterling Faucet's Satellite Dumps or FibAir's Satellite Dumps, consists of several places where foundry sand is present or suspected in and around Reedsville, West Virginia. For purposes of identification, the site has been given a street address of Third Street and Long Avenue, an intersection in the middle of town. Foundry sand from the former plumbing fixtures plant, Sterling Faucet in Reedsville was used as fill material and spread on land throughout the area [1]. Sterling Faucet operated another plumbing fixture plant in Morgantown, 15 miles away. Foundry sand in this area is primarily from the Reedsville plant. Foundry sand from the Morgantown facility is similar to the local product.

Foundry sand is gray, black, or orange to red. It is visible in many places in and around Reedsville. The October 2003 Extent of Contamination report stated visible foundry sand was a good indicator of soil containing 400 parts per million (ppm) lead or greater [2].

Plumbing fixtures were manufactured at a firm in Reedsville from the early 1950's until 1978. This activity is the apparent source of the foundry sand and sand molds observed in the area. Pittsburgh Tube & Valve Company operated this facility prior to 1969. Sterling Faucet operated the facility from 1969 to 1973. Rockwell International continued the foundry operations from 1973 until 1978. Fiberglass has been manufactured here since 1978. From 1978 to 1986 Fibair, Inc. owned the property. Hollinee L.L.C. has manufactured fiberglass air filters in this facility since 1986 [2]. The community refers to this facility as "Fibair."

Reedsville is a small community located about 15 miles southeast of Morgantown, West Virginia. It is a residential community with one manufacturer and small businesses serving the population in the rural area surrounding the town. The area around the town is forested or farm land. Coal mining has occurred in this area. Figure 1 shows the site location. The area is generally flat with some rolling hills. The land elevation in the area ranges from 1700 to 1850 feet.

Groundwater generally flows toward a geological structure called a syncline. The Ligonier Syncline underlies this area, running southwest to northeast, crossing Rt. 92 close to the Valley Elementary School access road. The syncline trough is east of the Arthurdale Water Commission wellfield. No foundry sand has been observed east of this syncline. However, it is uncertain how much effect the syncline has on the groundwater movement because underground features, such as former mines, can change groundwater movement [3].

Surface water flows into Kanes Creek and Deckers Creek from the 17 of the 18 areas evaluated at this site. Kanes Creek flows into Deckers Creek. Deckers Creek feeds the reservoir used by the Preston County Public Service District #1 (PSD#1) for drinking water. This reservoir is about 2 miles east of the site center. One area, the *Solomon property*, drains into Squires Creek.

The soils in this area range from moderately well drained to very poorly drained. Approximately 140 wetland acres are within a one-mile radius of the site. Most of these wetlands are downgradient of the site center [2]. The prevailing wind in the area is from the southwest to the northeast.

Areas of potential environmental concern

The United States Environmental Protection Agency (EPA) and West Virginia Department of Environmental Protection (WVDEP) identified 18 places for review. These are places where foundry sand existed, was suspected, and where children routinely come in contact with soil, e.g., the elementary school and former child daycare center. This report lists these areas by the same numbers as the WVDEP but arranges them by similar type. The locations are noted in Figures 2 and 3.

Areas with high lead content in the soil and/or high potential for exposure

Area 1 Arthur Road duplex

Area 1 is located south of Reedsville at the intersection of State Route 92 and Arthur Road (County Rt. 92/1). Foundry sand surrounds the foundation and is inside the fenced front yard of the duplex as well as the driving and parking areas. It surrounds an abandoned mobile home located at this intersection. The *Arthur Road duplex* is considered a separate site by the EPA (WVN000305694). Surface water drains southwest into an intermittent tributary of Deckers Creek. Visible foundry sand, apparently washed from the site by surface water, was observed in this tributary. This water moves toward the PSD#1 reservoir used as a drinking water source [4].

The EPA relocated a family with two young children from this duplex in September 2001, after WVDEP samples found lead in soil at 1,885 and 4,850 milligrams per kilogram (mg/kg). The children lived at this site on weekends. The duplex owner no longer rents to families with young children.

Area 10 Former Sterling Faucet facility - foundry sand disposal area

The *Former Sterling Faucet facility-foundry sand disposal area* is behind the Hollinee L.L.C. facility on Route 92 and First Street. EPA considers *Area 10* a separate site, named Sterling Faucet Reedsville (EPA # WVN000305670). *Area 10* consists of about 30 flat acres. Storm water flows across this site into Kanes Creek. *Area 10* is bounded on the north by the Rails to Trails path, on the east by the Hollinee L.L.C. plant, on the south by Kanes Creek and on the west by Deckers Creek and wooded areas. It is within easy walking distance from all the homes in Reedsville. The land is in two parcels, one owned by Hollinee L.L.C. and the other by an individual. Rockwell International is the potentially responsible party. An aerial photograph indicates foundry sand disposal occurred here prior to 1956. Access to *Area 10* was unrestricted until August 2003 when an orange plastic fence and "No Trespassing" signs were installed. The owner of one of the parcels recently re-contoured part of this property [5].

A clay or silt layer represents a physical barrier to contamination movement [1].

Area 15 Residential soil

Visible foundry sand and stressed vegetation were observed at the residential area along State Route 92 and the access road to the Hollinee plant (County Road 92/97) [4]. Although some of this property is close enough to Rt. 92 to be influenced by lead from vehicles burning lead-containing gasoline in the past, the stressed vegetation in this area is more indicative of the presence of foundry sand [6].

Area 13 Arthurdale school (and Fairfax pond area)

The former Arthurdale Elementary School and current Valley Elementary School are located south of Reedsville on County Route 92/96. The new school is adjacent to and northwest of the old school. No visible foundry sand or stressed vegetation was observed around the schools [4].

Area 14 Daycare in Reedsville

A children's daycare was located in the former elementary school in Reedville, west of State Route 92. The daycare operator said he did not believe foundry sand was located on this property. No visible foundry sand or stressed vegetation was observed on cursory review [4]. This property has been sold and the daycare center is closed.

Area 6 Solomon property

Area 6 is a residential property located on the south side of County Road 92/4 near County Road 56/4. Approximately 1,000 cubic yards of soil and foundry sand from the eastern portion of *Area 10 Former Sterling Faucet facility-foundry sand disposal area* was used to fill the yard. A layer of topsoil followed by a layer of clay, coal, and cinders covers the foundry sand. Healthy vegetation was observed in the fill area. No foundry sand was observed on the surface of the ground. Surface water drains into Squires Creek [2].

Area 7 New home area

Area 7 is off of Arthur Road, southeast of *Area 1*. A residence was under construction in *Area 7* in July 2003. No foundry sand was visible here. *Area 7* has open access to *Area 2* [2].

<u>Areas with high lead content in the soil and/or moderate potential for exposure</u>

Area 2 Open field area

Area 2 is located south of the Sheltered Workshop Road and consists of about two flat to gently sloping acres. Stressed vegetation and visible foundry sand were observed here. An aerial photograph indicates that foundry sand disposal occurred here prior to 1956. Access is unrestricted. People are using vehicles, trucks, and all terrain vehicles (ATVs) in this area. *Area 2* is within 100 feet of *Area 7* [4].

Area 3 Well house area

Area 3 is a one-half acre of flat land located southeast of *Area 2*. It is approximately 80 feet from the Sheltered Workshop Road. Foundry sand was visible on the ground west and northwest of the well house in a 25 foot-wide area. According to aerial photographs, foundry sand disposal occurred here prior to 1956.

At one time a chicken farm used water from this well. The use of this well for other purposes, such as drinking water, is unknown. The only access to the well was through the unstable wellhouse roof, so no attempt was made to sample the well [4].

Area 4 Rehe landfill stockpile

Area 4 is located along Sheltered Workshop Road southeast of Reedsville. This landfill is currently closed and monitored by the WVDEP under the Landfill Closure Assistance Program (LCAP). A stockpile containing foundry sand and soil was constructed during the LCAP activities. Soil has washed from the stockpile toward the stagnant water body next to Arthur Road. *Area 4* is close to a wetland and Fairfax pond, a potential source for drinking water. Access to *Area 4* is unrestricted [2].

Area 8 Landfill area adjacent to leachate pond

Area 8 is northeast of the Rehe landfill leachate pond. The picnic area for the Sheltered Workshop and a roof-bolt manufacturer are north of and very close to *Area 8*. Access to *Area 8* is unrestricted. Bare ground and stressed vegetation were observed. Wetlands are next to and downgradient from *Area 8* [2].

<u>Areas without elevated lead content in the soil and/or with low potential for exposure</u>

Area 5 Reclaimed strip mine area

Area 5 is located south of *Area 17 Former Preston County recycling center*. It is off of Arthur Road between Bethlehem and Reedsville. A locked gate and a fence restrict public access. Strip mining and logging activities have occurred here. Foundry sand disposal occurred here. Visible foundry sand was not observed in 2003 after logging in this area [4].

Area 9 Landfill area along perimeter fencing adjacent to Arthur Road (former slaughter house)

Area 9 is near Arthur Road. A concrete pad from a former slaughter house is in this area. Access from Arthur Road is restricted by the fencing and locked gate for the Rehe landfill. Access is unrestricted from Sheltered Workshop Road. *Area 9* was selected for review because aerial photography indicated stressed vegetation might occur here. However, no foundry sand or stressed vegetation was observed on the ground upon cursory review [2].

Area 11 Deckers Creek, upgradient from known foundry sand disposal areas

Deckers Creek receives surface water and soil runoff from several areas identified in this report. Visible foundry sand was observed in Deckers Creek near *Area 10 Former Sterling Faucet facility–foundry sand disposal area* [2].

Area 12 Kanes Creek (Kent Creek) sampled upstream and downstream from Area 10

Kanes Creek intersects Deckers Creek at the southwestern corner of *Area 10.* Kanes Creek receives surface water and soil runoff from the *Former Sterling Faucet facility–foundry sand disposal area*. No visible foundry sand was observed in Kanes Creek near *Area 10.* EPA and WVDEP references to Kent Creek are likely misspellings of Kanes Creek [2].

Area 17 Former Preston County recycling center

Area 17 is located north of Arthur Road, next to the Rehe landfill, and adjacent to *Area 9*. *Area 17* was selected for review because aerial photography indicated there might be stressed vegetation at this location. Foundry sand or stressed vegetation were not seen by on-site observers at *Area 17* [2].

Water sources

Public water sources

Two public water suppliers, Preston County PSD#1 and Arthurdale Water Commission currently serve this area.

Preston County PSD#1 began operation in 1971. The service area has been expanded several times since then, the most recent in 1995. It currently serves 2,765 people [7]. Preston County PSD#1 obtains water from the Deckers Creek Impoundment located about 2 miles east of the site center. Deckers Creek, the stream supplying the reservoir, is listed as impaired for aluminum, iron, pH, and manganese. Acid mine drainage is the likely source of these chemicals.

Fairfax pond, at *Area 13*, and Ruby's pond are being considered as supplementary water sources for the Preston County PSD#1. Ruby's pond was used as the drinking water source for the plumbing fixture and fiberglass plant from the 1970s until the spring of 1992.

The Arthurdale Water Commission serves 275 people using water from five wells. Valley Elementary School is their major customer. The wells are approximately 1.5 miles southwest and downgradient from the site center. This system has been in operation for at least 70 years. The date the current wells were put into operation is unknown. Lead-containing soils are noted within the groundwater protection zone of these wells [8].

Area 16 Homewells near Dick Arthur Road & Morgan mine

Private groundwater wells in *Area 16* were sampled to determine if nearby foundry sand is impacting the groundwater. *Area 16* is located along Arthur Road east and west of the intersection with County Route 92/1. Although foundry sand is nearby, groundwater is not expected to flow from the areas impacted by foundry sand toward these wells [4].

Area 18 Power line area

Area 18 is accessible from *Area 17 Former Preston County recycling center*. Stressed vegetation, visible foundry sand and a 103-foot deep well were found here. This well may have served a home in the past. It is not known if surface water is impacting this well because the well condition was not noted in the report [4].

Demographics

The population center for this site is along State Route 92 between Arthur Road and the Sheltered Workshop Road. This is not the site center. Forty three people live within 0.25 miles, 164 within 0.5 miles, and 722 within 0.75 miles of the population center [4]. About 500 people live in the Town of Reedsville.

The Hollinee plant is within 0.25 mile of approximately 40 residences.

About 450 students in grades K-5 attend Valley Elementary School between Reedsville and Arthurdale. The school employs 40 staff.

A daycare center was located in a former elementary school building about 0.33 mile NE of the Hollinee plant. The daycare served 10-15 children.

The Preston County Sheltered Workshop was located in the former Sterling faucet building until a few years ago when it moved to its present location, near the Rehe landfill on Sheltered Workshop Road about 0.75 miles south of the site center. Up to 25 disabled adults and four employees use this center. Jennmar Corp., a roof-bolt manufacturer, is located near the Sheltered Workshop. Jenmar employs about 100 people.

Community health concerns

The community is concerned about formaldehyde and methanol emissions from the Hollinee plant. The Hollinee plant manufactures fiberglass for filters. Community members believe chemicals in these emissions cause various cancers.

The Rails to Trails pathway passes close to the Hollinee plant and the former *Area 10 Sterling Faucet facility-foundry sand disposal area*. Community members are concerned that people using the trail will be harmed by chemical exposures in this area.

Discussion

Data review and selection of chemicals of concern

Samples were collected throughout the area where foundry sand was known or suspected to occur in the soil. Soil, sediment, surface water, groundwater, well water, and air sample results from the WVDEP, EPA, and WVDHHR were reviewed.

X-ray fluorescence tests for lead in soil were not reviewed. This is a screening test and not as accurate as the laboratory tests reviewed in this report. In all cases but one, the X-ray fluorescence result was lower than the laboratory test result.

Foundry sand is visible on the ground in many areas. This product has been in the environment for at least 25 years. Mixing with soil has occurred. The product will be treated as soil in this report because exposure to foundry sand and soil occur under the same circumstances.

Nine Geoprobe® groundwater samples were reviewed, as well as a background groundwater sample.

Public water system operators test for lead and copper to comply with the National Primary Drinking Water Regulations and the EPA. We reviewed this data on file in the Office of Environmental Health Services.

Selection of chemicals of concern

The first step in the assessment of human health risk is the selection of chemicals of concern. This process compares data from the site to environmental guideline comparison values (CVs). Comparison values are established on the basis of an evaluation of toxicology literature for a given substance. They are used as screening tools. Exposure to a chemical below its corresponding CV indicates that adverse health effects are unlikely. Many safety factors are included in the derivation of these values, making them very conservative (i.e., protective of public health). Chemicals found above a CV *do not necessarily mean* an adverse health effect will result from exposure. It simply indicates a *need for further evaluation* to determine if they *could have caused* adverse health effects at this site. Some chemicals have both carcinogenic (cancer-causing) and non-carcinogenic CVs. For chemicals with both carcinogenic and noncarcinogenic CVs, the most conservative CV (i.e., the lowest) was selected.

Three criteria are used to select chemicals of concern. They are test results indicated the chemicals were in the environment in amounts above the selected CVs, the chemical has no established CVs, or particular chemicals were of concern to the community. Using these criteria, we selected antimony, copper, and lead in soil as chemicals of concern. WVDHHR considered formaldehyde and methanol as chemicals of concern because the community was concerned about health effects from exposures to them.

Sample results below their respective comparison values are indicated in italics in the following tables.

Arsenic in soil was not selected as a chemical of concern although it was above the environmental comparison value. This was because it was within arsenic's normal range in eastern United States soils, <0.1 to 73 mg/kg [9]. Arsenic in the soil was found between 1.4 and 9.4 mg/kg, except for a soil sample near the well house. Pesticides and animal feed used at the poultry farm formerly operated in *Area 3* may have contained arsenic, which might explain the higher arsenic found here, 16 mg/kg [4, 10].

Lead was not found in any groundwater sample above the detection limit, 10 micrograms per liter (µg/L). The groundwater contained iron and manganese. This is expected in an area where coal exists. The accuracy data of metals data in groundwater is questionable because the homewell dissolved phase metals were greater than the total phase metals [4].

Lead and chromium were found in surface water in *Areas 1 and 5* slightly over the environmental comparison value for drinking water. These were not selected as chemicals of concern because exposure to chemicals in surface water is from incidental ingestion. Lead was found at 30 µg/L in surface water at *Area 5 Reclaimed strip mine area* and 15.4 µg/L at *Area 1*. Chromium was found at 33.2 µg/L at *Area 11*, 33.2 µg/L.

We averaged copper and lead in six samples of Ruby's pond water. We assumed all non-detections were equal to the detection limit. Copper was 48 µg/L (five samples at 5 µg/L and one sample at 260 µg/L). Lead averaged 5 µg/L (five samples at 2 µg/L and one sample at 20 µg/L). These amounts are well below the CV for drinking water.

Lead in the *Power line well* was not selected as a chemical of concern because the water is not used, and there is no human exposure to the well water.

No environmental data was reviewed for *Area 14 Daycare in Reedsville*.

Summary of the selection of chemicals of concern

The following chemicals of concern were identified:

	Soil	Sediment
Area 1 Arthur Road duplex	Copper and lead	Lead
Area 2 Open field area	Lead	
Area 3 Well house area	Antimony, copper, and lead	
Area 4 Rehe landfill stockpile	Copper and lead	
Area 5 Reclaimed strip mine area	Lead	
Area 8 Landfill area adjacent to leachate pond	Copper and lead	
Area 10 Former Sterling Faucet facility-foundry sand disposal area	Lead	
Area 15 Residential soil	Copper and lead	
Area 7 New home area (for pica only)	Lead	

No chemicals of concern for the incidental ingestion pathway were found in:

- *Area 6 Solomon property*
- *Area 7 New home area*
- *Area 9 Landfill area along perimeter fencing adjacent to Arthur Road*
- *Area 11 Deckers Creek, upgradient from known foundry sand disposal areas.*

- *Area 12 Kanes Creek (Kent Creek) sampled upstream and downstream from Area 10*
- *Area 13 Arthurdale school (and Fairfax pond area)*
- *Area 16 Homewells near Dick Arthur Road & Morgan mine*
- *Area 17 Former Preston County recycling center*

The comparison values (CVs) used in the following charts are:

Designation in charts	Full Name	Definition
EPA Action Level	EPA Action Level for drinking water	EPA Action Levels represent concentration of contaminant which, if exceeded, triggers treatment or other requirements which a public water system must follow.
RMEG child	Reference Media Evaluation Guide for a child	Reference Media Evaluation Guides represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects.
Int EMEG child	Environmental Media Evaluation Guide for a child for an Intermediate exposure time period	Environmental Media Evaluation Guides are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation. The intermediate exposure period is from 15-365 days of exposure.
EPA Soil SSL[11]	EPA Soil Screening Level	EPA Soil Screening Levels are estimates of contaminant concentrations not expected to result in noncarcinogenic health effects. This value takes into account the potential for the contaminant to migrate into groundwater.
Secondary EPA water standard	EPA National Secondary Drinking Water standard	The EPA National Secondary Drinking Water standards are guidelines for chemicals in water affecting cosmetic (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.
LTHA	Lifetime Health Advisory for Drinking Water	Lifetime Health Advisories are amounts of chemicals in drinking water not known or anticipated to cause noncarcinogenic health effects to persons exposed over a lifetime.

Abbreviations used in the charts are: µg/L for micrograms per liter and mg/kg for milligrams per kilogram. Data in italics means the number is below the CV. The data came from the WVDEP and the EPA [4-5, 10, 12-17].

<u>Areas with high lead content in the soil and/or high potential for exposure</u>

Area 1 Arthur Road duplex

Soil	Results in mg/kg						Comparison Value	
Antimony	*18.1*			20.7			20 mg/kg	RMEG child
Copper	15,000			15,900			500 mg/kg	Int EMEG child
Lead*	1,855	2,063	2,780	3,560	4,200	4,850	400 mg/kg	EPA Soil SSL
**Average lead content is 3,218 mg/kg*								

Surface water Unnamed Tributary of Deckers Creek	Results in µg/L			Comparison Value	
Lead	*<10*	*<10*	15.4	15 µg/L	EPA Action Level

Sediment Unnamed Tributary of Deckers Creek	Results in mg/kg			Comparison Value	
Copper	*14.4*		15,100	500 mg/kg	Int EMEG child
Lead	*11.7*	*13.4*	1,910	400 mg/kg	EPA Soil SSL

Area 10 Former Sterling Faucet facility-foundry sand disposal area

Lead in Soil			Comparison Value	
# samples/ # detections	Range over CV (mg/kg)*	# samples over CV		
71/71	402-4775	42	400 mg/kg	EPA Soil SSL
Average lead content is 1,395 mg/kg				
* NOTE: Samples were taken at various depths, all at a range starting at 0" and ending up to 3.3' below ground surface. The soils in *Area 10* have had at least one major disturbance, to level and re-contour the ground.				

The WVDEP measured formaldehyde in the soil in the Hollinee plant vicinity. No formaldehyde was detected in 3 tests in the plant vicinity. The detection limit was 1 mg/kg [15].

Air	Results from a personal air monitoring pump		Comparison Value
Lead	1 µg/m^3	For a 8 hour period during soil removal activities	none

Area 15 Residential soil

Soil	Results in mg/kg		Comparison Value	
Copper	*68.7*	1,070	500 mg/kg	Int EMEG child
Lead	*44.9*	413	400 mg/kg	EPA Soil SSL

Area 13 Arthurdale school (and Fairfax pond area)

Soil	Results in mg/kg			Comparison Value	
Lead	*9.2*	*12.7*	*31.5*	400 mg/kg	EPA Soil SSL

Surface water Fairfax pond	Results in µg/L			Comparison Value	
Lead	*<6.9*	*<6.9*	*<6.9*	15 µg/L	EPA Action Level

Sediment Fairfax pond	Results in mg/kg			Comparison Value	
Lead	*1.12*	*2.75*	*3.15*	400 mg/kg	EPA Soil SSL

Area 14 Daycare in Reedsville

No sample data for *Area 14* were found.

Area 6 Solomon property

Soil	Results in mg/kg					Comparison Value	
Lead	*15.5**	*(105)*	*(169)*	*(345)*	*(493)*	400 mg/kg	EPA Soil SSL
All samples taken at a depth of 10-38" except for * which was taken at the soil surface. No foundry sand was observed on the soil surface. The foundry sand was covered with clay, coal, cinders, topsoil, and grass.							
Results in parentheses were taken 10-38" below the surface. People are not exposed to soil 10-38" below the surface. Therefore, these sample results were not considered in the selection of chemicals of concern.							

Area 7 New home area

Soil	Results in mg/kg	Comparison Value	
Lead	*23.4*	400 mg/kg	EPA Soil SSL

<u>Areas with high lead content in the soil and/or moderate potential for exposure</u>

Area 2 Open field area

Soil	Results in mg/kg			Comparison Value	
Copper	6,400			500 mg/kg	Int EMEG child
Lead	1,480	2,280	3,100	400 mg/kg	EPA Soil SSL

Area 3 Well house area

Soil	Results in mg/kg			Comparison Value	
Antimony	86.4			20 mg/kg	RMEG child
Copper	66,500			500 mg/kg	Int EMEG child
Lead	3,500	4,750	6,890	400 mg/kg	EPA Soil SSL

Area 4 Rehe landfill stockpile

Soil	Results in mg/kg	Comparison Value	
Copper	10,700	500 mg/kg	Int EMEG child
Lead	2,280	400 mg/kg	EPA Soil SSL

Area 8 Landfill area adjacent to leachate pond

Sand	Results in mg/kg				Comparison Value	
Copper	9,540		5,940		500 mg/kg	Int EMEG child
Lead	1,500	2,093	2,110	5,350	400 mg/kg	EPA Soil SSL

Sand Mold	Results in mg/kg	Comparison Value	
Lead	763	400 mg/kg	EPA Soil SSL

Surface Water	Results in µg/L	Comparison Value	
Lead	*<10*	15 µg/L	EPA Action Level

<u>Areas without elevated lead content in the soil and/or with low potential for exposure</u>

Area 5 Reclaimed strip mine area

Sand	Results in mg/kg		Comparison Value	
Lead	1,040	1,110	400 mg/kg	EPA Soil SSL

Surface water	Results in µg/L	Comparison Value	
Lead	30	15 µg/L	EPA Action Level

Area 9 Landfill area along perimeter fencing adjacent to Arthur Road

Soil	Results in mg/kg		Comparison Value	
Lead	*10.8*	*8.5*	400 mg/kg	EPA Soil SSL

Area 11 Deckers Creek, upgradient from known foundry sand disposal areas

Surface Water	Results in µg/L			Comparison Value	
Chromium	*<10*	*<10*	33.2	30 µg/L	RMEG child
Lead	*<3*	*<3*	*<3*	15 µg/L	EPA Action Level

Sediment	Results in mg/kg			Comparison Value	
Lead	*10.6*	*17.4*	*26.4*	400 mg/kg	EPA Soil SSL

Area 12 Kanes Creek (Kent Creek) sampled upstream and downstream from Area 10

Surface Water	Results in µg/L		Comparison Value	
Lead	*<3*	*<3*	15 µg/L	EPA Action Level

Sediment	Results in mg/kg		Comparison Value	
Lead	*13.8*	*14.8*	400 mg/kg	EPA Soil SSL

Area 17 Former Preston County recycling center

Soil	Results in mg/kg	Comparison Value	
Lead	*72.9*	400 mg/kg	EPA Soil SSL

Sediment from pond	Results in mg/kg	Comparison Value	
Lead	*9.7*	400 mg/kg	EPA Soil SSL

Surface Water from pond	Results in µg/L	Comparison Value	
Lead	*<10*	15 µg/L	EPA Action Level

<u>Drinking Water and Groundwater</u>

Area 16 Homewells near Dick Arthur Road & Morgan mine and Area 18 Power line area

Well water	Results in µg/L (total phase)				Comparison Value	
	Well #1	Well #2	Well #3	Power line Well*		
Lead	<*3*	<*3*	<*3*	86.3*	15 µg/L	EPA Action Level
* The Power line well is abandoned and not used as a drinking water source						

Ruby's pond (anticipated source of public water)

Surface Water	Results in µg/L		Comparison Value	
Copper	<*5* (5 samples)	260 (1 sample)	100 µg/L	Int EMEG child
Lead	<*2* (5 samples)	20 (1 sample)	15 µg/L	EPA Action Level

Background

Background samples			
Surface water	Lead	<10 µg/L	0.75 mile E of Arthur Road duplex
	Lead	<10 µg/L	near Bethlehem Mines
	Copper	<10 µg/L	0.75 mile E of Arthur Road duplex
	Chromium	0.69 µg/L	0.75 mile E of Arthur Road duplex
Soil	Lead	14.2 mg/kg	0.75 mile E of Arthur Road duplex
	Copper	12.6 mg/kg	0.75 mile E of Arthur Road duplex
Sediment	Lead	13.4 mg/kg	Morgan mine area
	Copper	13.7 mg/kg	Morgan mine area
Groundwater	Lead	<3 µg/L	0.75 mile E of Arthur Road duplex
	Copper	413 µg/L	0.75 mile E of Arthur Road duplex

Background results were within the normal range of metals in eastern United States soils, below the West Virginia Groundwater Standards, or below the EPA National Primary and Secondary Drinking Water Standards, where established [9, 18].

Air emissions of formaldehyde and methanol

This report includes a discussion of formaldehyde and methanol air emissions due to community concerns. The Hollinee facility manufactures fiberglass. The plant produced 23,150 lb fiberglass per day, on average, in 1998 [19]. These processes released formaldehyde and methanol. The air emissions are regulated under a WVDEP permit.

Fiberglass is manufactured by spinning melted glass fibers onto a revolving drum. The product is sprayed with a urea-formaldehyde resin and coloring agents during this process. Urea-formaldehyde resins are converted into resins which allow glass fibers to become a fiberglass mat in ovens by controlled heating and pressure in the presence of catalysts. After leaving the ovens, the product is trimmed, sprayed with oil, and packaged [15].

By mid-2004, Hollinee had increased the stack height and installed a thermal-oxidation pollution control method for oven emissions. The new pollution control method substantially reduced formaldehyde and methanol emissions compared to the former scrubbing method. Greater emission dispersion occurred by increasing the stack height.

The prevailing winds at this site are from southwest to northeast. Emissions from the Hollinee plant likely move toward the town of Reedsville. The elevation of *Area 14 Daycare in Reedsville* is about 70 feet above the Hollinee plant.

Formaldehyde readings inside the facility smoking room (2.5 to 3.8 ppm) were greatest when smokers were present [20]. The portion of formaldehyde contributed from the manufacturing operations and cigarette smoke is impossible to determine. Other than the smoking room the highest formaldehyde value found in the Hollinee plant was in the burnoff and spinning room. Formaldehyde was found at 0.8 ppm in this area. Air sampling in 1980 by the West Virginia Department of Health (now WVDHHR) with Drager formaldehyde tube samplers indicated the formaldehyde in the spinning room ranged from >0.05 to 1.0 ppm. The 1.0 ppm reading was during a resin transfer operation. The Drager tube readings were taken before exhaust fans were installed in the spinning room [20].

More recently, an air sample taken near the exhaust fan from the facility furnace room detected formaldehyde but could not quantify it. Formaldehyde may have been as high as 0.053 ppm, because this is the detection limit for the air sampler [21].

Meter readings at locations on the plant grounds and in the residential area near the plant on sunny day in 2000 with a moderate breeze found formaldehyde from 0.1 to 0.3 ppm [22]. Meter readings on a cool and cloudy day in 2000 indicated formaldehyde on the plant grounds was 0.1 ppm or less. The formaldehyde level at the main intersection in Reedsville ranged between 0.1 ppm to 0.3 ppm [23]. The higher levels were recorded when traffic increased, which is reasonable because motor vehicle combustion produces formaldehyde.

Human exposure pathway analysis

An exposure pathway consists of five parts:

1. a source of contamination,
2. movement of the contaminant(s) into and through the environment (in soil, air, groundwater or surface water) to bring it into contact with people,
3. a place where humans could be exposed to the contaminant(s),
4. a way for humans to be exposed to the contaminant(s) (such as by drinking the water or breathing the air), and
5. one or more people who may be in contact with or have contacted the contaminant(s).

Exposure pathways are considered *complete* when all five of these elements existed at some point in the past, exist in the present, or are likely to occur in the future. Exposure pathways are considered *potential* when one or more of the elements are missing or uncertain but could have existed in the past, could currently exist, or could exist in the future. Pathways are considered *eliminated* when one or more of these five items do not exist or where conditions make exposures highly unlikely.

A completed pathway means people have been exposed to chemicals. That said, however, the existence of a completed pathway *does not necessarily mean that a public heath hazard existed* in the past, exists currently, or is likely to exist in the future. Chemicals found in the completed pathways were evaluated to determine whether adverse health effects could have occurred in the past, are occurring in the present, or could occur in the future.

Chemicals can get into the body in three ways.

- They can be ingested, by drinking water or eating food, taking in small amounts of contaminants through normal hand-to-mouth activities (called incidental ingestion), or by deliberately eating soil (called pica). Pica behavior is considered a potential method of exposure at places where children live in proximity to lead-containing soil.
- Chemicals can get into the body through the skin. This is called dermal exposure. The dermal pathway is not considered in this report because metals, such as lead and copper, are not absorbed through the skin easily. It is assumed not enough foundry sand chemicals could be absorbed through the skin to cause adverse health effects.
- In addition, chemicals can get into the body is by breathing them (inhalation).

The source of contamination at this site is the foundry sand generated by the former plumbing fixtures manufacturing facility in Reedsville. The pathways discussed here are outlined in Appendix B, Table 1.

Soil – residential and recreational exposure via incidental ingestion – completed pathway for the past, present, and future

Foundry sand has been placed on the ground in many areas. It has mixed with soil. Foundry sand is present in areas where people can contact it when they play, garden, or work in these soils. People can get chemicals from the soil into their bodies through incidental ingestion. Small children have more hand-to-mouth activities than adults and are more likely to ingest contaminants in soil. Therefore, the soil exposure pathway is completed. This pathway is complete for the past, present, and future for;

- *Area 1 Arthur Road duplex,*
- *Area 2 Open field area,*
- *Area 3 Well house area,*
- *Area 4 Rehe landfill stockpile,*
- *Area 5 Reclaimed strip mine area,*
- *Area 8 Landfill area adjacent to leachate pond,*
- *Area 10 Former Sterling Faucet facility-foundry sand disposal area,* and
- *Area 15 Residential soil.*

Soil – residential exposure via pica – potential pathway for the past, present and future

Pica behavior is the act of eating soil. Between 4% and 21% of children have a tendency toward pica. Children who exhibit pica behavior are at increased risk from exposures to chemicals in the soil because they ingest more soil. We assumed young children who live at *Area 1 Arthur Road duplex, Area 7 New Home area*, and *Area 15 Residential soil* might eat 5,000 milligrams of soil for 45 days a year over 6 years. We have no reports this behavior occurred. This is a potential pathway for the past, present, and future until pica behavior can be confirmed or site conditions change.

Soil – residential and recreational exposure via incidental ingestion – eliminated pathway for the past, present, and future

No chemicals of concern were found in soil where human contact could occur at;

- *Area 6 Solomon property,*
- *Area 7 New home area,*
- *Area 9 Landfill area along perimeter fencing adjacent to Arthur Road,*
- *Area 13 Arthurdale school (and Fairfax pond area),*and
- *Area 17 Former Preston County recycling center.*

The pathway was eliminated for *Area 14 Daycare in Reedsville* because no foundry sand was determined in this area either from cursory visual inspection or knowledge of the property owner [4].

Surface water – residential and recreational exposure via incidental ingestion – completed pathway for the past, present, and future

Chemicals in foundry sand could move with water that has been in contact with foundry sand-containing soils. At least one chemical of concern was found at;

- *Area 1 Arthur Road duplex,*
- *Area 5 Reclaimed strip mine area,* and
- *Area 11 Deckers Creek, upgradient from known foundry sand disposal areas.*

This pathway is completed for the past, present, and future because at least one chemical of concern is present in the surface water and humans can contact the surface water.

Surface water – residential and recreational exposure via incidental ingestion – eliminated pathway for the past, present, and future

No chemicals of concern were found in surface water in;

- *Area 8 Landfill adjacent to leachate pond,*
- *Area 12 Kanes Creek (Kent Creek) sampled upstream and downstream from Area 10,* and
- *Area 17 Former Preston County recycling center.*

Surface water – drinking water pathway for PSD#1 customers – eliminated for the past and present - potential pathway for the future

Chemicals in foundry sand could move with water flowing into Deckers Creek and subsequently into the water reservoir used by the PSD#1 for a drinking water source. No lead and copper regulatory violations for PSD#1 drinking water were found in WVDHHR files. In addition to these tests, WVDEP samples from *Kanes Creek*, where a lot of foundry sand was in the soil near *Area 10*, found no lead above 3 µg/L, the detection limit. The minimal presence of lead and copper in the water of PSD#1 eliminates the drinking water pathway for the past and present. However, because the potential for lead and copper to wash into the reservoir used by PSD#1 exists, there is a potential pathway for the future.

Fairfax pond and Ruby's pond were evaluated for the drinking water pathway. These waters are being considered for use for PSD#1 in the future. Similar to the PSD#1 reservoir, lead and copper have not been found in amounts likely cause adverse health effects. The potential remains for lead and copper to enter these ponds in the future.

Sediment – residential and recreational exposure via incidental ingestion - completed pathway for the past, present, and future

Foundry sand enters streams either by being placed directly in them or from surface water moving the foundry sand particles into a stream. The foundry sand, or the chemicals from it, could accumulate in stream sediment. People could get these chemicals into their body by hand-to-mouth activities after contact with the sediment. Copper and lead have been found in sediment at *Area 1 Arthur Road duplex* where residents and recreational users could come into contact with it. Therefore, the sediment exposure pathway is completed for *Area 1*. This pathway is complete for the past, present, and future.

Sediment – residential and recreational exposure via incidental ingestion - eliminated pathway for the past, present, and future

No chemicals associated with foundry sand were found in quantities of concern for human health in the sediment at;

- *Area 11 Deckers Creek, upgradient from known foundry sand disposal areas,*
- *Area 12 Kanes Creek (Kent Creek) sampled upstream and downstream from Area 10,*
- *Area 13 Arthurdale school (and Fairfax pond area),* and
- *Area 17 Former Preston County recycling center.*

Therefore, the incidental ingestion pathway is eliminated for these areas for the past, present, and future.

Groundwater drinking water from private wells – potential pathway for the future

Chemicals in foundry sand-containing soil could dissolve into water as it moves from the surface into the water table. People could be exposed to chemicals in the water table when they drink water from water wells. Both private and public water wells exist in this area. No chemicals of concern were in the private water wells tested in *Area 16* or the wells used by the Arthurdale Water System. Although lead was found in well water at *Area 18 Power line area*, this well is not used as a drinking water source. There is no human exposure to this water. The groundwater pathway is considered potential because chemicals from this source might contaminate drinking water wells in the future.

Groundwater – drinking water pathway for Arthurdale Water Commission customers – eliminated for the past and present, potential pathway for the future

Chemicals in foundry sand could move into the groundwater in the wellfield used by the Arthurdale Water Commission. Although groundwater is expected to flow toward these wells from areas without foundry sand impacts, groundwater may flow from these areas. No lead or copper regulatory violations for Arthurdale Water Commission drinking water were found in WVDHHR files. Therefore, the drinking water pathway for the Arthurdale Water Commission water is eliminated for the past and present. A potential pathway for the drinking water pathway exists for the future because chemicals from foundry sand could influence the groundwater in the future.

Air (chemicals from foundry sand) - inhalation – potential pathway for the past, present, and future

Wind could move the foundry sand into the air. People breathing air in this area could inhale the foundry sand particles and be exposed to the chemicals. A worker wore an air monitor for 8 hours while working at *Area 10*. Lead in the air was found at 1 $\mu g/m^3$. This level is substantially below the amount of lead in air known to cause adverse health effects. This may reflect the worst case scenario for lead from foundry sand in the air. However, because soil removal activities occurred during this monitoring, this may not reflect conditions in other areas. Therefore, the air exposure pathway is termed a potential pathway for the past, present, and future.

Air (chemicals from fiberglass manufacturing operations) – inhalation - completed pathway for the past, present, and future

The chemicals released from the fiberglass manufacturing operations are in the air. People breathe the air in this area. There is a completed pathway for exposure to chemicals from the fiberglass manufacturing operation.

Biota – eliminated pathway for the past, present, and future

People who eat plants or animals from this site are unlikely to be exposed to enough lead or copper to cause adverse health effects.

Fish are not expected to accumulate lead and copper in their tissues at higher levels than what is in the water and sediment in their environment. Copper and lead were not found at levels likely to cause adverse health effects in people exposed directly to surface water and sediment. Therefore, the potential for exposure to lead and copper at high enough levels to cause adverse health effects in people who eat fish caught at this site is not likely.

Plants do not usually accumulate copper. Plants can accumulate lead from soil under conditions that may or may not be present at this site. No plants grew in areas where soil contained significant levels of lead and copper. Home gardens or orchards were not observed in these areas. Therefore, lead and copper from foundry sand is not affecting edible plants.

The potential for game animals to accumulate copper or lead in their tissues is unlikely because they move from eat plants from many areas. The biota pathway is eliminated. People are unlikely to be exposed to enough chemicals in plants or animals to cause adverse health effects.

Exposure analysis

Calculation of exposure doses

Estimated exposure doses (expressed as milligrams per kilogram per day or mg/kg/day) were calculated based on formulas explained in Appendix C. The assumptions used to calculate the exposure doses are noted in Tables 2, 3, and 4 in Appendix B and Appendix C. The assumptions used for incidental ingestion and pica require a persistent pattern of ingestion or contact with water, soil, or sediment. Most people are unlikely to contact soil or sediment as often as assumed in the calculations. For these reasons, the estimated exposure doses for incidental ingestion are greater than would likely occur to any person at this site.

Calculation of the risk of elevated blood lead levels

The EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) for predicting blood lead levels in children under 7-years-old was used to assess potential health effects from lead exposures at this site. The model estimates the probability that a typical child will have blood lead concentrations over the level of concern, 10 micrograms per deciliter (μg/dL). The model assumes that children will be exposed to lead from outdoor soil, dust in the home, air, drinking water, and diet. The model does not estimate exposure to lead-based paint in homes. A time-weighted average of lead exposures at the site and residential exposures were used to estimate children's blood lead levels.

A different model was used to estimate adult blood lead levels because they encounter and absorb lead in different ways than children.

More information about these models and the time-weighted averaging method used to generate the blood level estimates are in Appendix C.

Selection of chemicals to be reviewed for noncarcinogenic effects

The estimated exposure doses calculated for the chemicals of concern using site specific exposure assumptions were compared to health-based comparison values (CVs) (Tables 2, 3, and 4). ATSDR Minimal Risk Levels (MRLs) and EPA Reference Doses (RfDs) are examples of health-based CVs containing exposure concentrations protective of public health. Where estimated exposure doses were below these health-based CVs, the chemical of concern was eliminated from further review. This means exposures to these chemicals at these levels are not expected to result in adverse health effects.

All chemicals of concern for which estimated exposure doses were over the health-based CV, or for which there was no health-based CV, were selected for further review for possible health consequences from exposures at this site. The estimated exposure doses for these chemicals was compared to research, such as that outlined in the ATSDR toxicological profiles, indicating health effects from chemical exposure in particular amounts. An exposure dose where no effects are observed is known as the no-observed-adverse effect level (NOAEL). The lowest exposure dose where an adverse health effect is observed is called the lowest-observed-adverse effect level (LOAEL).

Selection of chemicals to be reviewed for carcinogenic effects

Formaldehyde was reviewed for possible carcinogenic effects in this community. Measured and modeled formaldehyde air concentrations were directly compared to the doses found in toxicological literature.

Theoretical cancer risks were calculated based on recent environmental data, although cancers develop over many years from past exposures. The method assumes past exposure to carcinogenic chemicals is the same as at currently measured levels.

Cancer risk estimates are based on many conservative assumptions. The actual cancer risk is probably lower than the calculated number. The true risk is unknown. It could be as low as zero. The method also assumes no safe level for exposure to a carcinogen. This means there is a very good chance the cancer risk is actually lower, perhaps by several orders of magnitude. One order of magnitude is 10 times greater or lower than the original number. Similarly, two orders of magnitude are 100 times, and three orders of magnitude are 1,000 times greater or lower than the original number.

Finally, evaluating the probable or actual exposure scenarios and noting the uncertainties noted above, WVDHHR ranked the exposure doses or cancer risks according to the following criteria. Theoretical cancer risks less than one in 10,000 were considered a very low risk and are not discussed in the text. Theoretical cancer risks between 1 and 9.9 in 10,000 were classified as a low risk, 10 and 99 as a moderate risk, and greater than 99 in 10,000 as a significant risk.

Possible health consequences from chemical exposures at this site

WVDHHR selected the following chemicals to review for possible health consequences because they met the selection criteria noted above:

- Pica exposures to lead in soil at *Area 1 Arthur Road duplex, Area 7 New home area* and *Area 15 Residential soil;* copper in *Area 1* and *Area 15;* and antimony in *Area 1* (Table 4).
- Incidental ingestion of copper in soil in *Area 1 Arthur Road duplex, Area 3 Well house area, Area 15 Residential soil, Area 4 Rehe landfill stockpile and Area 8 Landfill area adjacent to leachate pond;* and sediment in *Area 1* (Table 2).
- Incidental ingestion of lead in soil and sediment in the nine areas where at least one estimated exposure dose was 0.0001 mg/kg/day or greater (Table 2).
- Exposure to formaldehyde and methanol in the air.

Other estimates were low enough that no additional review for possible health consequences was needed.

Antimony

Antimony is a metal naturally found in soil. It is used in many manufacturing processes. Antimony attaches to soil or sediment particles containing iron, manganese, or aluminum. Gastrointestinal effects (vomiting) have occurred in people following acute oral exposure to antimony.

The highest estimated exposure dose to antimony in the soil at *Area 1 Arthur Road duplex* is 0.001 mg/kg/day for a child who eats soil (pica behavior) 45 days a year for 6 years. This exposure dose was 500 times less than what Dunn (1928) found caused vomiting in humans (0.53 mg/kg/day). Also, this is a very conservative exposure estimate because we assumed 100% antimony absorption even though the scientific literature indicates only a small amount of ingested antimony is absorbed into the body. The other estimated doses for routine (non-pica) soil exposures were lower than that found at *Area 1*. Therefore, exposure to antimony in the soil at this site is not likely to cause adverse human health effects in children or adults [24].

Copper

Copper is a naturally occurring metal. Copper is used in combination with other metals to form alloys. Bronze and brass are two alloys containing copper. Copper attaches to organic and inorganic materials in soil. Copper does not generally enter the groundwater because it binds to particles and thus stays in the soil. Copper is needed by humans for good health but high amounts can cause health problems. No human studies show copper causing cancer. Some people are genetically susceptible to copper and get liver disease from copper exposures. However, these conditions are rare.

Exposure doses to copper in soil *in Area 1* and *15* via pica ingestion were greater than the ATSDR Acute Oral MRL (0.01 mg/kg/day).

Exposures to copper in soil and sediment via incidental ingestion in *Areas 1, 3, 4, 8, and 15* were greater than the ATDR Intermediate Oral MRL (Tables 2 & 4).

These estimated exposure doses were compared to a study by Pizarro in 1999. This study found the LOAEL for humans ingesting copper (as sulfate) was 0.0731 mg/kg/day. People experienced abdominal pain and nausea at exposure levels estimated in this study. An uncertainty factor of three was applied to account for differences in the way individuals might react to the same amount of copper. We found several exposure scenarios which may result in adverse health effects.

- a resident child 0.5-6 years-old exposed to copper on-site soil via pica behavior at *Area 1 Arthur Road duplex* 45 days a year for 6 years (0.98 mg/kg/day)
- a resident child 1-6 years-old exposed to on-site soil via incidental ingestion at *Area 1 Arthur Road duplex*, 280 days a year for 5 years (0.17 mg/kg/day)

- a resident child 1-6 years-old exposed to on-site sediment via incidental ingestion at *Area 1 Arthur Road duplex*, 280 days a year for 5 years (0.16 mg/kg/day)
- a resident child 0.5-6 years-old exposed to on-site soil via pica behavior at *Area 15 Residential soil* for 45 days a year for 6 years (0.07 mg/kg/day)
- a trespassing child 2-6 years-old exposed to on-site soil via incidental ingestion at *Area 3 Well house area*, 40 days a year for 5 years (0.04 mg/kg/day)

Nausea and abdominal pain are possible adverse health effects to children exposed to copper in the soil under the conditions outlined above at *Areas 1, 3*, and *15*. These effects would be expected to stop shortly after the exposure to these soils ends.

Copper was not tested in the soil at *Area 10 Former Sterling Faucet facility–foundry sand disposal area*. Based on the data showing lead and copper occurring together at this site, *Area 10* is assumed to have a high copper level, in addition to its high lead levels. Therefore, the same gastrointestinal effects might occur in people exposed to soil in *Area 10* [25].

Lead

Lead is a metal naturally found in the environment. Batteries, pipe, ammunition, and some ceramics and glassware contain lead. Lead in the soil usually sticks to the soil particles. Lead can move into the groundwater when the water is acidic or “soft”. This movement is dependent on the lead’s chemical composition and the soil type. Lead can cause a variety of health problems depending on the exposure and the time of life when a person is exposed.

Exposures to lead are most dangerous to young and unborn children. Normal hand to mouth behavior exposes children to more lead than adults. Activities stirring up dust, such as crawling, walking, sweeping, renovation, and the wind’s action are likely to impact children more than adults because children play on or near the ground. Exposures to lead from many sources impact children. The most significant and common source of lead exposure is children’s ingestion of paint chips containing lead. However, this factor is not considered in this report. Once lead is in a child’s body, more is retained compared to an adult. Exposures to lead as a fetus or young child can cause low birth weight, reduced growth rate, and low IQ. Exposure to low levels of lead at critical times during development can have permanent effects on learning and behavior.

Children absorb about 30% of lead from soil while adults absorb about 12%. This report assumed lead absorption from foundry sand is equivalent to soil.

Lead exposure for children 0.5 – 6 years-old who eat soil (pica behavior) was estimated at 0.09 mg/kg/day in *Area 1 Arthur Road duplex*, 0.01 mg/kg/day in *Area 15 Residential soil*, and 0.0004 mg/kg/day in *Area 7 New Home area* (Table 4). These exposures were compared to a study by Stuik (1974). Changes in blood enzymes were found at lead exposures of 0.02 mg/kg/day. A safety factor of three was applied to the LOAEL in this study. Therefore, changes in blood enzymes might occur at exposures of 0.007 mg/kg/day. Pica behavior in *Area 1* and

Area 15 may result in changes in young children's blood while exposures in *Area 7* are not likely to result in adverse health effects.

The review of possible health consequences for incidental ingestion in children was based on modeled blood lead levels. Estimated exposure doses in Tables 2 and 3 supported the modeled results (Table 5).

The highest blood lead estimate for children was 24.9 µg/dL for a 1-2 year-old child who lived at *Area 1 Arthur Road duplex* and played outside in the soil 280 days a year. The model estimated blood lead level at or above 15.9 µg/dL for children in all age ranges primarily due to dust exposure in the *Area 1* home.

Children who played 80 days a year at *Area 1* and who brought a significant portion of lead from this area's soil into their residence (other than *Area 1*) were at risk for elevated blood lead levels up to 5-years-old (range from 10.5 to 13.6 µg/dL.) We assumed 25% of residential dust came from lead-containing soil at *Area 1*. However, transfer of this amount of soil to an off-site location on shoes, clothes, and playthings is highly unlikely.

No modeled exposures raised blood lead levels over 10 µg/dL from lead at *Area 10* even when significant lead was transferred to off-site residences.

Significant adverse health effects might occur from exposures to lead in foundry sand at *Area 1 Arthur Road duplex*. Children who live year round in this duplex and contact the soil via incidental ingestion 280 days a year might develop blood anemia, muscle weakness, and changes in the brain.

The CDC level of concern for lead levels in children is any blood lead level over 10 µg/dL. There are no effective ways to reduce children's blood lead levels below 10 µg/dL. However, some researchers have found exposure to lead at levels that do not raise the blood lead level to 10 µg/dL can cause adverse health effects in children. Some possible effects from these exposures are subtle changes in brain function (Payton et al. 1998), changes in the cardiovascular system that can be detected in children's electrocardiograms (Silver and Rodriguez-Torres 1968), growth retardation (Shukla et al. 1989), and changes in the blood (Chisolm et al. 1985) [26]. These effects might be observed in children exposed to lead in foundry sand at this site.

Adults can be exposed to more lead than children without experiencing adverse health effects. The adult blood lead level for exposures to lead in soils in *Area 1* soil for 80 days a year was estimated as 3.39 µg/dL. Exposure to dust in the *Area 1* home (composed primarily from outside soil) for a year would raise blood lead levels to 6.9 µg/dL. No adverse health effects would be expected in adults exposed to this soil under these conditions. Since *Area 1* had the highest lead in soil, no other adult blood lead estimates were made [26].

The 11th Report on Carcinogens listed lead and lead compounds as reasonably anticipated to cause cancer. Studies have found workers in lead industries with a small increased cancer incidence [27]. However, these workers were exposed to other cancer-causing chemicals under very different conditions than those at this site. The studies did not determine if these other chemicals were influencing the cancer findings. Additionally, animals developed cancer when exposed to extremely high amounts of lead. However, the cancer in animals may have been caused in ways not relevant to the lead exposures found at this site. Because of this ATSDR believes there is inadequate evidenced to determine lead's carcinogenicity in humans under conditions found at this site.

Formaldehyde

Formaldehyde is both a natural and a manufactured chemical. Formaldehyde is created when things burn. There are many common environmental formaldehyde sources; cigarette smoke, gas and kerosene heaters, open fireplaces, latex paint, fingernail polish, engine exhaust, and gases from carpet and plywood. Formaldehyde is used in urea-formaldehyde resins. The average formaldehyde exposure from secondhand smoke is 0.23 to 0.27 ppm (or 283 to 332 micrograms per cubic meter [$\mu g/m^3$]) [28].

Formaldehyde breaks down into formic acid and carbon monoxide in the environment. Most formaldehyde in the air breaks down in sunlight. Formaldehyde quickly breaks down into other chemical compounds when dissolved in water. It readily dissolves in water. Formaldehyde does not accumulate in plants or animals.

Formaldehyde is produced during normal human metabolism. Formaldehyde entering the body is used in the body's normal metabolic pathway. This pathway changes formaldehyde into formate and carbon dioxide. Formaldehyde does not accumulate in the body [29].

Formaldehyde in the air can irritate the eyes, nose, and throat. This generally occurs at air concentrations of 0.4 - 3.0 ppm. Some people will have irritation at lower air concentrations. Formaldehyde does not cause asthma but may trigger asthma attacks in sensitive people.

Some studies have found people exposed to formaldehyde at work have more nose and upper throat cancers (nasopharyngeal) than other people. However, most studies do not support this conclusion. Agencies have evaluated these studies and have designated formaldehyde as a carcinogen. The International Agency for Research on Cancer states there is sufficient data to say formaldehyde exposure can cause nasopharyngeal cancer. The National Toxicology Program of the US Department of Health and Human Services classifies formaldehyde as reasonably anticipated to be a carcinogen. The US EPA classifies it as a probable human carcinogen based on limited human and sufficient animal studies.

Air sampling in the area near the Hollinee facility and in and around Reedsville found formaldehyde between 0.1 and 0.3 ppm (123 and 369 $\mu g/m^3$). This sampling was done in 2000 before the Hollinee stack height was increased. Formaldehyde sampled outside the plant includes formaldehyde from many sources. The relative contribution from the Hollinee plant to these readings cannot be determined. The highest measured value, 0.3 ppm, was noted to occur at a highway intersection when trucks were passing by. This is expected since engine exhaust is known to contain formaldehyde. Studies show outside air formaldehyde concentrations vary significantly and often correlate with traffic conditions [29].

The WVDEP estimated the maximum annual average formaldehyde concentration from Hollinee at 0.38 $\mu g/m^3$ (0.0003 ppm). This concentration was determined to be 0.23 miles from the stack.[1] [30]. They used the model called SCREEN3. The estimate was made after the stack height had been increased. Because weather data specific to Reedsville is not available, WVDEP used various conservative assumptions. This means if there were uncertainties in the assumed values, the weather conditions more likely to result in a greater concentration of emissions at ground level were selected.

Formaldehyde exposure cancer risk estimates were made by multiplying the EPA inhalation unit risk for formaldehyde, $(0.000013\ \mu g/m^3)^{-1}$, with the formaldehyde air concentration. Exposures to the maximum annual average formaldehyde concentration modeled from the Hollinee emissions add less than one additional cancer in 10,000 people. Estimates of excess cancers from exposure to the formaldehyde measured in the air in Reedsville (0.1 ppm [123 $\mu g/m^3$] to 0.3 ppm [369 $\mu g/m^3$]) are 16-48 in 10,000. However, these formaldehyde levels cannot be attributed to any particular source.

In addition to the potential cancer risk for nose and upper throat cancers (nasopharyngeal), formaldehyde in the air in the community could irritate the eyes, nose, and throat as well as trigger (but not cause) asthma in sensitive populations.

Methanol

Methanol, also known as wood alcohol, is both a natural and a man-made chemical. Methanol is produced by many plants as they grow and when they decay. Many foods contain methanol, such as legumes, baked potatoes, and roasted filberts. Methanol is found in windshield wiper fluid, Sterno®, automobile exhaust, and cigarette smoke. Air contains 0.001 to 0.025 ppm (or 0.76 to 19 $\mu g/m^3$) methanol, on average.

Methanol is normally found in the human body. Methanol is metabolized to formaldehyde and then to formic acid and carbon dioxide in the liver. Toxicity from methanol is known to occur when people ingest large amounts. Methanol does not accumulate in the human body unless large amounts of methanol enter the body [31]. Studies have shown that humans can be exposed to more than 200 ppm (262,000 $\mu g/m^3$) methanol in the air over 6 hours without evidence of the accumulation of methanol metabolism byproducts. Methanol is not carcinogenic [32].

Methanol levels in the community's ambient air were not measured. However, given the low toxicity when inhaled, methanol levels at this site are not expected to be high enough to cause adverse health effects.

Community health concerns

Community concerns were gathered during a WVDHHR community meeting in July 2003 and from letters and petitions to WVDEP officials.

1 These calculations used the emissions from the stack to estimate ground level formaldehyde. The ground level readings of formaldehyde noted above could have measured formaldehyde from other sources.

Is formaldehyde contaminating the soil and groundwater in this area?

Formaldehyde breaks down quickly in the air in sunlight. It dissolves quickly in water where it breaks down into other chemicals quickly. Formaldehyde was not detected (i.e., present at <1 mg/kg) in foundry sand in *Area 10 Former Sterling Faucet facility-foundry sand disposal area* adjacent to the fiberglass plant.

Methanol is metabolized in the body to formaldehyde. Isn't exposure to methanol as harmful as to the formaldehyde?

A metabolic pathway constantly forms and metabolizes methanol and formaldehyde in the body. Methanol is metabolized to formaldehyde which is broken down into formic acid and carbon dioxide. Methanol is not known to cause the eye and nose irritation associated with formaldehyde. No studies indicate methanol is carcinogenic to humans or animals.

I can smell formaldehyde in the air. Is this harmful?

Most people can smell formaldehyde at low levels. Some people will experience burning eyes and nose and throat irritation between 0.5 and 1.0 ppm. Formaldehyde does not cause asthma but may trigger asthma attacks in some sensitive people. Some human studies show a relationship between exposure to formaldehyde in air and development of nose and upper throat (nasopharyngeal area) cancers. The risk of developing nose and throat cancers from the Hollinee plant emissions was estimated to be less than 1 in 10,000 while the risk from inhalation of formaldehyde in the air in Reedsville, from multiple sources, was estimated at 16-48 in 10,000. This was considered a very low to moderate excess cancer risk.

Lead containing soil has been removed to an area next to the community water source and the Valley Elementary School. Is this a hazard?

Lead found in the soil near the Valley Elementary School was not at levels considered harmful to children. Low lead levels were found in Fairfax pond sediments. Lead was not detected in Fairfax pond water (see *Area 13* discussion).

There is a lot of cancer in this community. Is it caused by the chemicals at this site?

The 11th Report on Carcinogens listed lead and lead compounds as reasonably anticipated to cause cancer [27]. Small increases in lung and stomach cancer have been observed in lead-industry workers. However, these workers were exposed to other cancer causing chemicals under very different conditions than those at this site. The studies did not determine if these other chemicals were influencing the cancer findings. Additionally, animals given extremely high doses of lead developed cancer. However, the cancer in animals may have been caused in ways not relevant to the lead exposures at this site. Because of this, ATSDR believes there is inadequate evidence to determine lead's carcinogenicity in humans under conditions found at this site.

The cancer associated with formaldehyde exposures is nose and upper throat cancer (nasopharyngeal). These cancers are not very common. The number of nose and throat cancers in

Preston County is small enough that one case more or less in a year causes a large change in the cancer rate. This means that rates for a small population are not "stable." The number of nose and throat cancers in the area is too few to release under West Virginia Cancer Registry privacy guidelines.

Leukemia and myeloma, cancers of concern to this community, are not associated with any chemicals reviewed in this report.

Preston County has a slightly higher rate of deaths from cancer than West Virginia as a whole (based on 1998-2002 five year crude rates per 100,000 population) [33].

Are other illnesses a result of the chemicals found at this site?

The community is concerned that illnesses, other than cancer, are caused by chemicals at this site. The illnesses mentioned were asthma, medical conditions requiring hysterectomy, lupus, Crohn's Disease, multiple sclerosis, and migraines. Of these illnesses, only asthma has been linked to chemicals at this site. Asthma is not caused by formaldehyde exposure. However, one large study of asthma found some people may be more sensitive to the effects of inhaled formaldehyde than others. Other studies show no relationship between asthma symptoms and formaldehyde exposure [29].

Is it safe to use the Rails to Trails path beside the Hollinee plant and the Former Sterling Faucet facility- foundry sand disposal area?

Adverse health effects from lead and copper in the foundry sand in this area were estimated to occur only after incidental ingestion of soils containing high amounts of these chemicals occurring at least 80 days a year. This exposure is not likely to occur on the paved trail. Children playing at *Area 10* who bring significant amounts of soil home from this area were not likely to have adverse health effects from exposures (Table 5). The formaldehyde measured in air was not greater on the Hollinee property next to this trail than in Reedsville. For these reasons, no adverse health effects are expected to occur to people who use the Rails to Trails path.

Evaluation of health outcome data

Screening of 123 children in the Arthurdale and Reedsville areas showed that five children had blood lead levels above 10 µg/dL. Only one of these children had a confirmed blood lead level above 10 µg/dL. This child was exposed to soil containing 490 mg/kg lead in addition to lead-based paint in the home.

Child health considerations

The many differences between children and adults demand special consideration. Children can be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and often use hand-to-mouth behaviors increasing their exposure potential. Children are shorter than adults. This means they breathe dust, soil, and vapors close to the ground. Children are smaller than adults which results in a greater dose of a substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, access to medical care, and risk identification. This public health assessment considered potential health effects to children to assist adults who make decisions regarding their children's health.

Exposure to lead and copper in soil containing foundry sand was evaluated at this site. Lead exposure at several residences and one area where foundry sand is clearly visible was high enough that neurological damage might occur to young children routinely exposed to the soil. Copper was also evaluated and found likely to cause gastrointestinal effects. These effects would not occur after copper exposures stopped.

Conclusions

The Reedsville Scattered Foundry site poses a **public health hazard** because of chronic exposure of children to lead and copper in on-site soil and sediment in *Area 1 Arthur Road duplex* and copper in soil at *Area 3 Well House area*. The site also poses a **public health hazard** for children who eat soil (pica behavior) because of acute exposure to lead and copper in soil in *Area 1 Arthur Road duplex* and *Area 15 Residential soil*.

Exposures to lead

- Lead in the soil and sediment at the *Area 1 Arthur Road duplex* could cause adverse health effects to young children (under 7) who live here and ingest soil when playing outside and from exposure to household dust inside the duplex. Possible health effects include subtle decreases in IQ, muscle weakness, and anemia. These effects may have happened in the past and may occur in the future under the same exposure conditions.
- Children who deliberately eat soil (pica behavior) in *Area 1 Arthur Road duplex* and *Area 15 Residential soil* may also have changes in their blood from exposure to lead in these soils.
- Exposures to lead in the soil, sediment, and surface water via incidental ingestion in *Areas 2-18* at this site were not determined high to raise children's blood lead levels over the CDC level of concern, 10 µg/dL. However, some researchers believe *any* elevation of blood lead levels in children will cause measurable adverse health effects. Some of these effects are subtle changes in brain function (Payton et al. 1998), changes in the cardiovascular system that can be detected in children's electrocardiograms (Silver and Rodriguez-Torres 1968), growth retardation (Shukla et al. 1989), and changes in the blood (Chisolm et al. 1985) [26].
- A data gap exists about whether exposure to lead from air-borne foundry sand particles is a potential health hazard. Many places containing foundry sand have no vegetation. Wind might move lead-containing particles into the air where they may be inhaled.

Exposures to copper

Exposure to copper in soil via incidental ingestion in *Area 1 Arthur Road duplex* and in *Area 3 Well house area* may have caused short term nausea, vomiting, abdominal pain, and diarrhea in children. Similar adverse health effects may occur in children who eat soil (pica behavior) at *Area 1 Arthur Road duplex* and *Area 15 Residential soil*. These short-term adverse health effects may have occurred in the past, may be currently occurring or likely to occur in the future.

Exposures to formaldehyde and methanol

Exposure to formaldehyde in the air at this site may cause eye, nose, and throat irritation and may trigger asthma attacks in sensitive people. Formaldehyde exposures may result in a low to moderate risk of developing nose and upper throat (nasopharyngeal) cancers. These health effects may have occurred in the past, are occurring in the present, and may occur in the future. Exposure to methanol in the air in this area is not expected to cause adverse health effects.

Recommendations

1. Parents should not allow their children to eat soil (pica behavior) in areas where foundry sand is visible or known to be on the ground and should limit children's soil contact in *Area 1 Arthur Road duplex*, and *Area 3 Well house area*.
2. Young children who are routinely exposed to soil containing foundry sand should have blood lead tests conducted by their health care provider.
3. The WVDEP or EPA discuss ways the *Arthur Road duplex* owner could reduce exposure of children to the lead in the soil at this property, such as covering the soil with material, such as blacktop, non-contaminated soil, or vegetation to preclude contact.
4. WVDHHR recommends the *Arthur Road Duplex* advise all renters who are parents of the presence of lead on the property and suggestions for reducing exposures to occupants and visitors.
5. WVDHHR should ask the public's assistance identifying other possible foundry sand disposal areas and private water wells located in areas containing foundry sand.
6. WVDEP or EPA should take air samples and measure foundry sand particle size to determine if inhaling wind-blown foundry sand could be hazardous.
7. If additional soil testing occurs, copper and tin should be tested in *Area 10 Former Sterling Faucet facility-foundry sand disposal area.* High levels of copper associated with the foundry sand indicates that bronze, and therefore tin, may be present in this material.

Public health action plan

1. WVDHHR will contact the *Arthur Road duplex* owner to provide continuing education about the lead hazards and encourage him to reduce lead and copper exposures to young children on his property.

2. WVDHHR will assist the blood-lead testing activities of the Preston County Health Department.
3. WVDHHR will provide community education events in the Reedsville area on ways to avoid lead and copper in their environment.
4. WVDHHR will evaluate additional environmental sample data from this site when available.
5. WVDHHR will notify the WVDEP of possible foundry sand disposal areas and private water wells that have not been assessed, as this information becomes available.

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Certification

This Reedsville Scattered Foundry Waste Cerclis site Public Health Assessment was prepared by West Virginia Department of Health and Human Resources (WVDHHR) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation of ATSDR has reviewed this public health assessment and concurred with its findings.

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APPENDIX A

Figures

Figure 1. Site Location

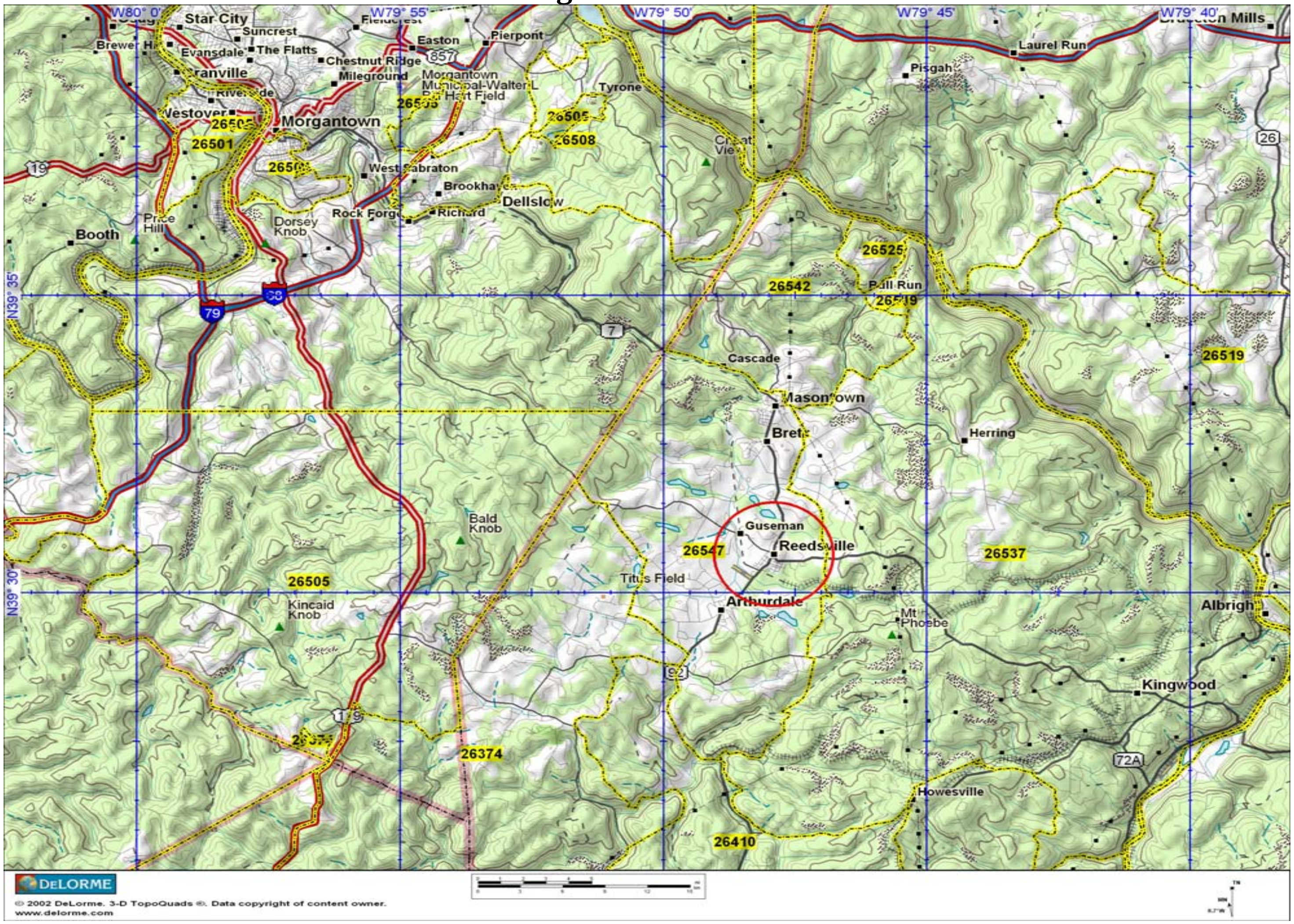


Figure 2. Area Location Map (1)

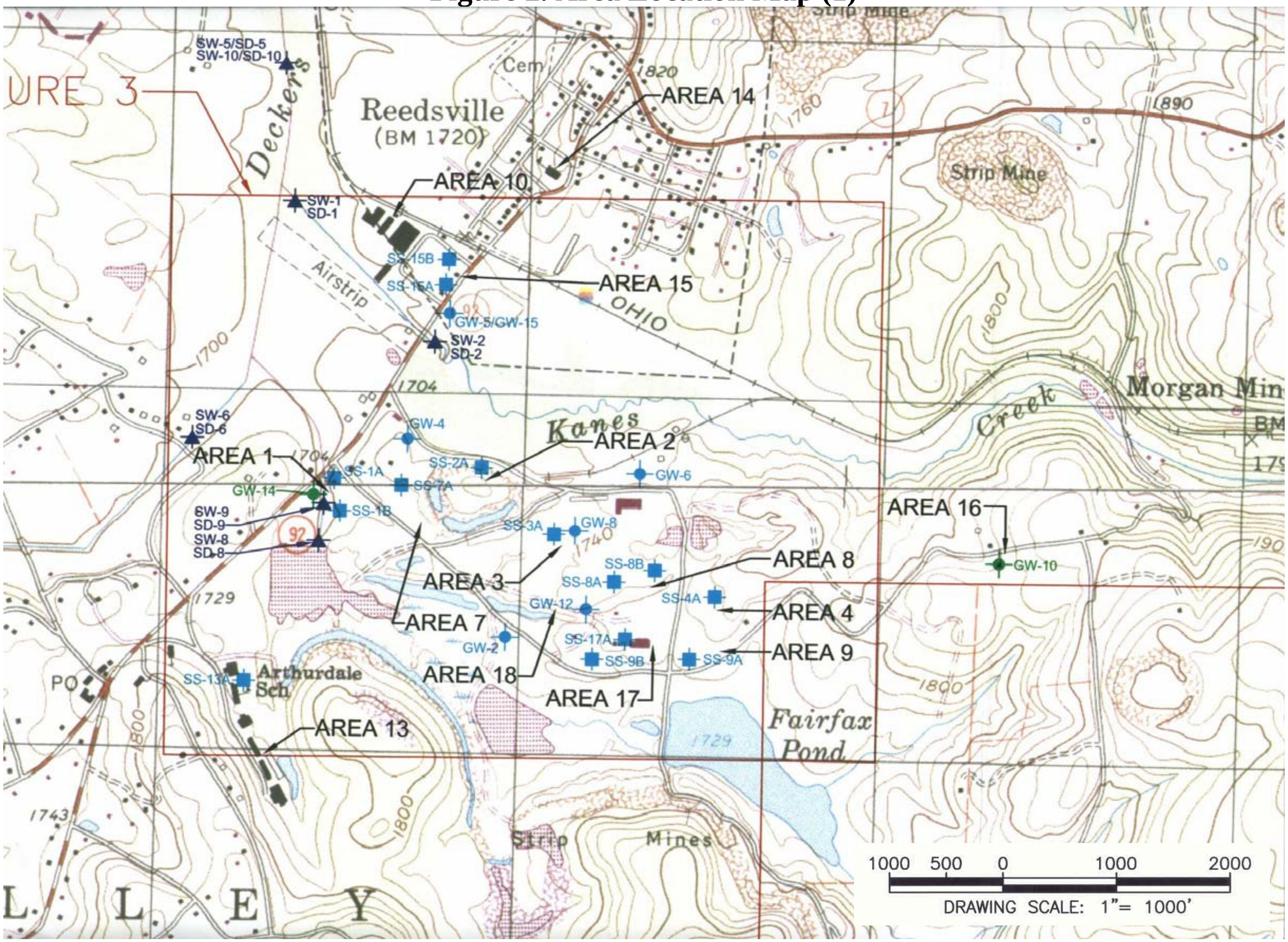
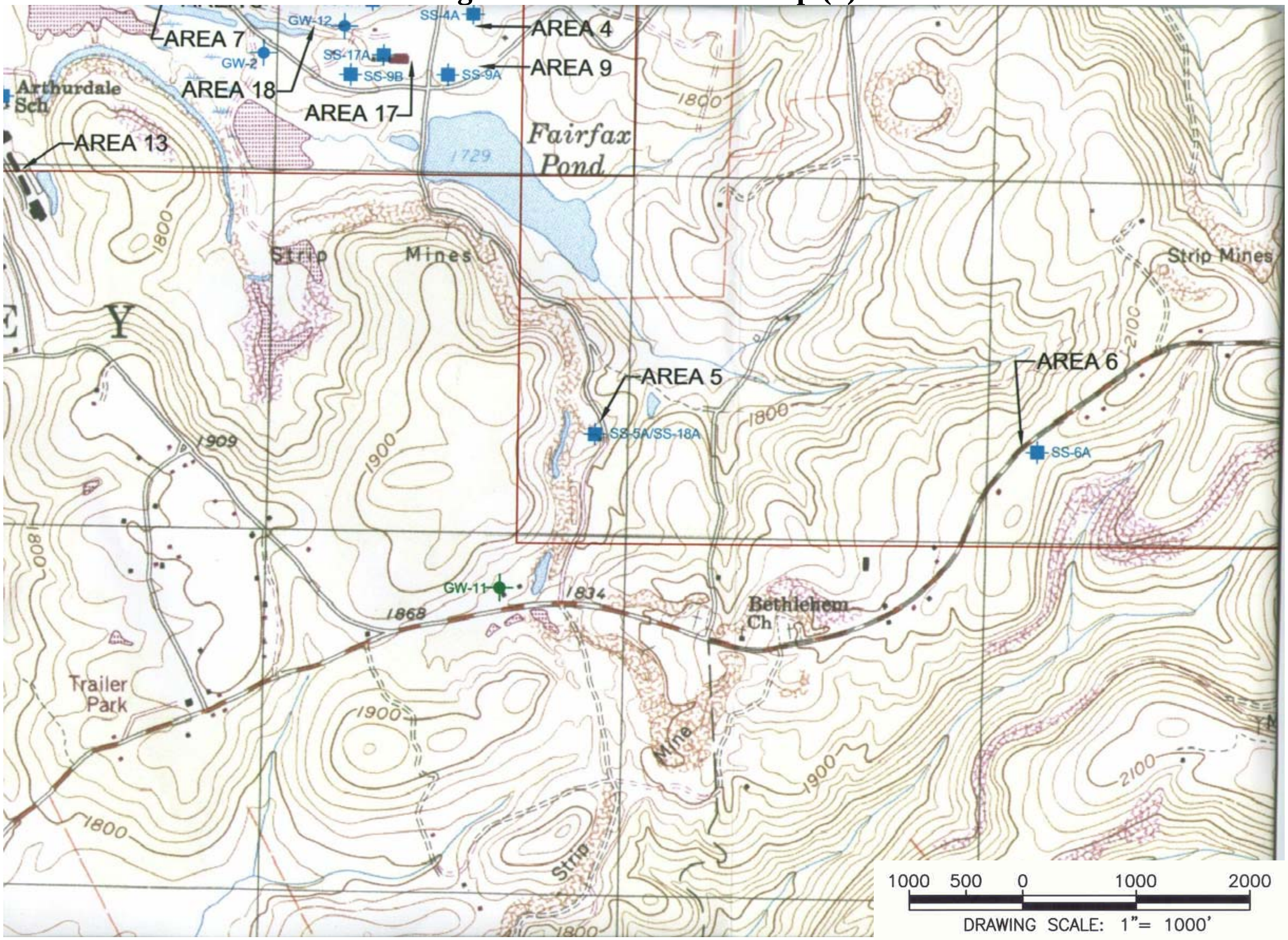


Figure 3. Area Location Map (2)



APPENDIX B

Tables

Table 1: Exposure Pathways to foundry sand or chemicals containing foundry sand							
Reedsville Scattered Foundry Waste Site							
Pathway	Exposure Elements						Type pathway
	Medium	Point of Exposure	Route of Exposure	Time	Exposed Population		
Soils in Areas 1,2,3,4,5,8,10 and 15	Soil	surface soils in residential and recreational areas	Incidental Ingestion	past, present and future	residents and recreational users	completed
Soil in Areas 1, 7 and 15	Soil	soil in Area 1	Pica	past, present and future	residents 0.5 to 6 years old	potential
Soils in Areas 6,7,9,13,and 17	Soil	surface soils in residential areas	Incidental Ingestion	past, present and future	residents	eliminated
		surface soils in recreational areas	Incidental Ingestion	past, present and future	recreational users	eliminated
Surface water Areas 1, 5, 8, 12, and 17	Surface water	surface water in residential and recreational areas	Incidental Ingestion	past, present and future	recreational users	eliminated
Surface water Area 11	Surface water	surface water in recreational area	Incidental Ingestion	past, present and future	recreational users	completed
Surface water used by PSD#1 and potential use of water in Fairfax pond and Ruby's pond	Surface water	water in reserviors used for drinking water	Ingestion	past and present	users of surface water - public water	eliminated
				future	users of surface water - public water supply	potential
Sediment in Area 1	Sediment	sediment in residential areas	Incidental Ingestion	past, present and future	residents and recreational users	completed
Sediment in Areas 11, 12, 13, and 17	Sediment	sediment in recreational areas	Incidental Ingestion	past, present and future	recreational users	eliminated
Air	Contaminant from foundry sand	particles of sand & soil in the air	Inhalation	past, present and future	nearby population	potential

Table 1: Exposure Pathways to foundry sand or chemicals containing foundry sand						
Reedsville Scattered Foundry Waste Site						
Pathway	Exposure Elements					Type pathway
	Medium	Point of Exposure	Route of Exposure	Time	Exposed Population	
Air	Contaminant from fiberglass manufacturing operation	air	Inhalation	past, present and future	nearby population	completed
Groundwater, Arthurdale Water System	Groundwater	groundwater used in public drinking water wells	Ingestion	past and present	users of groundwater - public wells	eliminated
				future	users of groundwater - public wells	potential
Groundwater, Area 16	Groundwater	groundwater used in private drinking water wells	Ingestion	past, present and future	users of groundwater - private wells	potential
Groundwater, Area 18	Groundwater	water in well	Ingestion	past,present and future	none	eliminated
Biota	Contaminant from foundry sand bioaccumulating from surface water and sediments into fish tissue	fish	Ingestion	past, present and future	people who eat fish caught near this area	eliminated
	Contaminant from foundry sand bioaccumulating from surface water and sediments into plants	garden produce	Ingestion	past, present and future	people who eat garden vegetables grown in this area	eliminated
	Contaminant from foundry sand bioaccumulating from surface water and sediments into game animals	game animals	Ingestion	past, present and future	people who eat game animals caught near this area	eliminated

Table 2: Estimated Exposure Doses and Cancer Risk for Incidental Ingestion of Soil and Sediment									
Reedsville Scattered Foundry Site									
Contaminant	Max level mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health-based guideline (CV)	
		Recreational exposures			Residential exposures			mg/kg/day	Source
		Child 2-6 years old	Child 7-16 years old	Adult > 16 years old	Child 1-6 years old	Child 7-16 years old	Adult > 16 years old		
Areas with high lead content in the soil or high potential for exposure (*exposure frequency (1) assumptions used*)									
Area 1. Arthur Road duplex									
Antimony (soil)	20.7	0.00003	0.00001	0.00001	0.00022	0.00002	0.00001	0.0004	EPA Chron Oral RfD
Copper (soil)	15,900	**0.019**	**0.008**	0.005	**0.168**	**0.012**	0.005	0.01	ATSDR Int Oral MRL
Copper (sediment)	15,100	**0.018**	**0.007**	0.005	**0.160**	**0.011**	0.005	0.01	ATSDR Int Oral MRL
Lead (soil)	4,850	**0.0018**	**0.0007**	**0.0005**	**0.0154**	**0.0011**	**0.0005**		none
Lead (sediment)	1,910	**0.0007**	**0.0003**	**0.0002**	**0.0061**	**0.0004**	**0.0002**		none
Area 6. Solomon property									
Lead (soil)	15.5	n/a	n/a	n/a	<0.0001	<0.0001	<0.0001		none
Area 7. New home area									
Lead (soil)	23.4	n/a	n/a	n/a	**0.0001**	<0.0001	<0.0001		none
Area 10. Former Sterling Faucet facility - foundry sand disposal area									
Lead (soil)	4,775	**0.0029**	**0.0012**	**0.0007**	n/a	n/a	n/a		none
Area 13. Arthurdale school (and Fairfax pond area)									
Lead (soil)	31.5	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Lead (sediment)	3.15	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Area 15. Residential soil									
Copper (soil)	1,070	n/a	n/a	n/a	**0.011**	0.001	<0.001	0.01	ATSDR Int Oral MRL
Lead (soil)	413	n/a	n/a	n/a	**0.0013**	**0.0001**	<0.0001		none

Table 2: Estimated Exposure Doses and Cancer Risk for Incidental Ingestion of Soil and Sediment									
Reedsville Scattered Foundry Site									
Contaminant	Max level mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health-based guideline (CV)	
		Recreational exposures			Residential exposures			mg/kg/day	Source
		Child 2-6 years old	Child 7-16 years old	Adult > 16 years old	Child 1-6 years old	Child 7-16 years old	Adult > 16 years old		
Areas with high lead content in the soil and moderate potential for exposure (*exposure frequency (2) assumptions used*)									
Area 2. Open field area									
Copper (soil)	6,400	0.004	0.002	0.001	n/a	n/a	n/a	0.01	ATSDR Int Oral MRL
Lead (soil)	3,100	**0.0006**	**0.0002**	**0.0001**	n/a	n/a	n/a		none
Area 3. Well house Area									
Antimony (soil)	86.4	0.00005	0.00002	0.00001	n/a	n/a	n/a	0.0004	EPA Chron Oral RfD
Copper (soil)	66,500	**0.040**	**0.016**	**0.010**	n/a	n/a	n/a	0.01	ATSDR Int Oral MRL
Lead (soil)	6,890	**0.0013**	**0.0005**	**0.0003**	n/a	n/a	n/a		none
Area 4. Rehe landfill stockpile									
Copper (soil)	10,700	**0.007**	0.003	0.002	n/a	n/a	n/a	0.01	ATSDR Int Oral MRL
Lead (soil)	2,280	**0.0004**	**0.0002**	**0.0001**	n/a	n/a	n/a		none
Area 8. Landfill area adjacent to leachate pond									
Copper (soil)	9,540	**0.006**	0.002	0.001	n/a	n/a	n/a	0.01	ATSDR Int Oral MRL
Lead (soil)	5,350	**0.0010**	**0.0004**	**0.0003**	n/a	n/a	n/a		none
Lead (sand mold)	763	**0.0001**	**0.0001**	<0.0001	n/a	n/a	n/a		none

Table 2: Estimated Exposure Doses and Cancer Risk for Incidental Ingestion of Soil and Sediment									
Reedsville Scattered Foundry Site									
Contaminant	Max level mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health-based guideline (CV)	
		Recreational exposures			Residential exposures			mg/kg/day	Source
		Child	Child	Adult	Child	Child	Adult		
		2-6 years old	7-16 years old	> 16 years old	1-6 years old	7-16 years old	> 16 years old		
Areas without elevated lead content or with low potential for exposure (***exposure frequency (3) assumptions used*** **)**									
Area 5. Reclaimed strip mine area									
Lead (soil)	1,110	**0.0001**	<0.0001	<0.0001	n/a	n/a	n/a		none
Area 9. Landfill area along perimeter fencing adjacent to Arthur Road (former slaughterhouse)									
Lead (soil)	10.8	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Area 11. Deckers Creek									
Lead (soil)	26.4	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Area 12. Kanes Creek (Kent Creek)									
Lead (sediment)	14.8	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Area 17. Former Preston County recycling center									
Lead (soil)	72.9	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none
Lead (sediment in pond)	9.7	<0.0001	<0.0001	<0.0001	n/a	n/a	n/a		none

Table 2: Estimated Exposure Doses and Cancer Risk for Incidental Ingestion of Soil and Sediment

Reedsville Scattered Foundry Site

Contaminant	Max level mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health-based guideline (CV)	
		Recreational exposures			Residential exposures			mg/kg/day	Source
		Child 2-6 years old	Child 7-16 years old	Adult > 16 years old	Child 1-6 years old	Child 7-16 years old	Adult > 16 years old		

Assumptions								
		Receational exposure			Residential exposure			
		Child	Child	Adult	Child	Child	Adult	
Age range	years	2-6	7-16	>16	1-6	7-16	>16	Absorption of lead in soil and sediment was assumed to be 30%
Ingestion rate	kg/day	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	
Exposure frequency (1)	days/year	80	80	80	280	124	80	
Exposure frequency (2)	days/year	40	40	40	n/a	n/a	n/a	
Exposure frequency (3)	days/year	14	14	14	n/a	n/a	n/a	
	years	5	10	55	5	10	55	
Body Weight	kilograms	18	45	70	14.5	45	70	

Items in **bold** are reviewed further in the text because the estimated exposure estimates exceed the health-based guideline or there was no health-based guideline.

ppm = parts per million equivalent to mg/kg or milligrams per kilogram

mg/kg/day = milligram per kilogram per day

CV = comparison value

(1) Exposure frequency for areas with high lead content in the soil or high potential for exposure (Areas 1, 6, 7, 10, 13 and 15)

(2) Exposure frequency for areas with high lead content in the soil and moderate potential for exposure (Areas 2, 3, 4, and 8)

(3) Expsoure frequency for areas without elevated lead content or low potential for exposure (Areas 5, 9, 11, 12, and 17)

ATSDR Int Oral MRL = ATSDR intermediate oral minimal risk level for exposures between 15 and 365 days

EPA Chron Oral RfD = EPA chronic oral reference dose for exposures over 365 days

Table 3. Estimated Exposure Doses & Cancer Risk for Ingestion of Contaminants in Surface Water Reedsville Scattered Foundry Site									
Contaminant	Max level (mg/L)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health-based guidelines (CV)	
		Recreational exposures			Residential exposures			mg/kg/day	Source
		Child	Child	Adult	Child	Child	Adult		
		2-6 years old	7-16 years old	> 16 years old	1-6 years old	7-16 years old	> 16 years old		
Area 1 Arthur Road Duplex									
Lead	0.0154	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001		none
Area 5 Reclaimed Strip Mine Area									
Lead	0.03	<0.00001	<0.00001	<0.00001	n/a	n/a	n/a		none
Area 11 Deckers Creek									
Chromium	0.0332	<0.00001	<0.00001	<0.00001	n/a	n/a	n/a	0.003	EPA Chron Oral RFD
Ruby's pond									
Copper	0.26	n/a	n/a	n/a	0.018	0.006	0.007	0.01	ATSDR Int Oral MRL
Copper (average amount)	0.048	n/a	n/a	n/a	0.003	0.001	0.001	0.01	ATSDR Int Oral MRL
Lead	0.02	n/a	n/a	n/a	0.00138	0.00044	0.00057		none
Lead (average amount)	0.005	n/a	n/a	n/a	0.00034	0.00011	0.00014		none

Table 3. Estimated Exposure Doses & Cancer Risk for Ingestion of Contaminants in Surface Water

Reedsville Scattered Foundry Site

Assumptions							
		Recreational Exposure			Residential exposure		
		Child	Child	Adult	Child	Child	Adult
Age range	years	2-6	7-16	over 16	1-6	7-16	over 16
Ingestion Rate (1) & (2)	liters/day	0.01	0.01	0.01	0.01	0.01	0.01
Ingestion Rate (3)	liters/day	n/a	n/a	n/a	1	1	2
Exposure frequency (1)	days/year	80	80	80	280	124	80
Exposure frequency (2)	days/year	14	14	14	n/a	n/a	n/a
Exposure frequency (3)	days/year	n/a	n/a	n/a	365	365	365
Exposure frequency	years	5	10	55	5	10	55
Body Weight	kilograms	18	45	70	14.5	45	70

mg/L = milligram per liter

mg/kg/day = milligram per kilogram per day

CV = comparison value

ATSDR Int Oral MRL = ATSDR intermediate oral minimal risk level for exposures between 15 and 365 days

EPA Chron Oral RfD = EPA chronic oral reference dose for exposures over 365 days

(1) Area 1. Areas with high lead content in the soil or high potential for exposure

(2) Areas 5 and 11. Areas without elevated lead content or with low potential for exposure

(3) Ruby's Pond. Surface water with potential for use in public water systems

Table 4: Estimated Exposure Doses and Cancer Risk for Pica Ingestion of Soil				
Reedsville Scattered Foundry Site				
Contaminant	Max level mg/kg (ppm)	Child 0.5-6 years old	Health-based guideline (CV) mg/kg/day	Type of CV
Areas with residential exposure to high lead content in the soil				
Area 1 Arthur Road duplex				
Antimony	20.7	**0.001**		none
Copper	15,900	**0.980**	0.01	ATSDR Acute Oral MRL
Lead	4,850	**0.090**		none
Area 7 New Home area				
Lead	23	**0.0004**		none
Area 15 Residential soil				
Copper	1,070	**0.066**	0.01	ATSDR Acute Oral MRL
Lead	413	**0.008**		none

Assumptions		
		Child
Age range	years	0.5-6
Ingestion rate	kg/day	0.005
Exposure frequency	days/year	45
	years	6
Body Weight	kilograms	10

Absorption of lead in soil was assumed to be 30%

Items in **bold** are reviewed further in the text because the estimated exposure estimates exceed the health-based guideline or there was no health-based guideline.

mg/kg (ppm) = milligrams per kilogram (parts per million)

mg/kg/day = milligram per kilogram per day

CV = comparison value

ATSDR Acute Oral MRL = ATSDR acute oral minimal risk level for exposures between 1 and 14 days

Table 5. Time weighted aveage method estimating blood lead levels of children exposed to foundry sand Reedsville Scattered Waste Site								
	A	B	C	D	E	F	G	H
Calculation			AxB=C			DxE=F	C+F=G	G/365
Age Group	Blood level (µg/dL) from exposure in the area*	Days per year playing in the area	Blood level times days	Blood level (µg/dL) from exposure at the residence*	Days per year inside residence	Blood level times days	Add blood level at areas and residence (to reflect 365 days a year)	Divide to 365 to get a time weighted average
Child who lives and plays at Area 1. (Assume residential dust content of 2,262 mg/kg from tracked in foundry sand averaging 3,218 mg/kg lead)								
0.5-1	21.7	280	6,076	21.7	85	1844.5	7,920.5	**21.7**
1-2	24.9	280	6,972	24.9	85	2116.5	9,088.5	**24.9**
2-3	23.7	280	6,636	23.7	85	2014.5	8,650.5	**23.7**
3-4	23.4	280	6,552	23.4	85	1989	8,541.0	**23.4**
4-5	20.3	280	5,684	20.3	85	1725.5	7,409.5	**20.3**
5-6	17.7	280	4,956	17.7	85	1504.5	6,460.5	**17.7**
6-7	15.9	280	4,452	15.9	85	1351.5	5,803.5	**15.9**
Child who plays at Area 1 - 80 days a year who brings significant amounts of lead-containing soil to the residence. (Assume residential dust lead content coming from soil containing 32 mg/kg (75%) and 3,218 mg/kg (25%) lead)								
0.5-1	21.7	80	1,736	9.1	285	2593.5	4,329.5	**11.9**
1-2	24.9	80	1,992	10.4	285	2964	4,956.0	**13.6**
2-3	23.7	80	1,896	9.8	285	2793	4,689.0	**12.8**
3-4	23.4	80	1,872	9.4	285	2679	4,551.0	**12.5**
4-5	20.3	80	1,624	7.8	285	2223	3,847.0	**10.5**
5-6	17.7	80	1,416	6.6	285	1881	3,297.0	9.0
6-7	15.9	80	1,272	5.9	285	1681.5	2,953.5	8.1
Child who plays at Area 1 - 80 days a year who does not bring significant amounts of lead-containing soil to the residence. (Assume residential dust lead content coming from soil containing 32 mg/kg lead)								
0.5-1	21.7	80	1,736	2.1	285	598.5	2,334.5	6.4
1-2	24.9	80	1,992	2.1	285	598.5	2,590.5	7.1
2-3	23.7	80	1,896	2	285	570	2,466.0	6.8
3-4	23.4	80	1,872	1.9	285	541.5	2,413.5	6.6
4-5	20.3	80	1,624	1.7	285	484.5	2,108.5	5.8
5-6	17.7	80	1,416	1.6	285	456	1,872.0	5.1
6-7	15.9	80	1,272	1.5	285	427.5	1,699.5	4.7
Child who plays at Area 10 - 80 days per year who brings significant amounts of lead-containg soil to the residence. (Assume residential dust content coming from soil containing 32 mg/kg (75%) and 1,395 mg/kg (25%) lead)								
0.5-1	12.8	80	1,024	5.4	285	1539	2,563.0	7.0
1-2	14.8	80	1,184	6.1	285	1738.5	2,922.5	8.0
2-3	14	80	1,120	5.7	285	1624.5	2,744.5	7.5
3-4	13.5	80	1,080	5.4	285	1539	2,619.0	7.2
4-5	11.4	80	912	4.5	285	1282.5	2,194.5	6.0
5-6	9.7	80	776	3.9	285	1111.5	1,887.5	5.2
6-7	8.6	80	688	3.5	285	997.5	1,685.5	4.6
Child who plays at Area 10 - 80 days per year who does not bring significant amounts of lead-containing soil to the residence. (Assume residential dust content coming from soil containing 32 mg/kg lead)								
0.5-1	12.8	80	1,024	2.1	285	598.5	1,622.5	4.4
1-2	14.8	80	1,184	2.1	285	598.5	1,782.5	4.9
2-3	14	80	1,120	2	285	570	1,690.0	4.6
3-4	13.5	80	1,080	1.9	285	541.5	1,621.5	4.4
4-5	11.4	80	912	1.7	285	484.5	1,396.5	3.8
5-6	9.7	80	776	1.6	285	456	1,232.0	3.4
6-7	8.6	80	688	1.5	285	427.5	1,115.5	3.1
µg/dL = micrograms per deciliter								
mg/kg = milligram per kilogram								
** Blood lead levels were estimated using the EPA Integrated Expoure Uptake Biokinetic Model for Lead in Children*								

APPENDIX C

Calculations and Assumptions used to Estimate Exposure Doses

Body weight assumptions

Body weight (*bw*) assumptions used are 14.5 kilogram (kg) (about 32 pounds or lb) for a 1-6 year old child, 18 kg (about 40 lb) for a 2-6 year old child, 45 kg (about 99 lb) for a 7-16 year-old child, and 70 kg (about 154 lb) for a person over 18.

Exposure factor calculation

The exposure factor (*ef*) is the time period exposure to a chemical is assumed to occur divided by the total time period during which the exposures could occur. For instance, the exposure factor for a person exposed 80 days a year for 6 years out of a lifetime of 70 years is 0.22. The formula for this example is:

$$\frac{\text{80 days per year (actual exposure time) } \textit{times} \text{ 5 years (actual exposure time)}}{\text{365 days per year (total days in a year) } \textit{times} \text{ 5 years (actual exposure time)}}$$

Assumptions for exposure time used in the incidental ingestion exposure frequency calculations		
80 days/year	High Exposure potential: Recreational child and adult	Assume 2 days a week for 40 weeks (snow cover for 10 weeks a year and a 2 week vacation).
40 days/year	Moderate Exposure potential: Recreational child and adult	Assume 1 days a week for 40 weeks (snow cover for 10 weeks a year and a 2 week vacation).
14 days/year	Low Exposure potential: Recreational child and adult	Assume a total of no more than 2 weeks a year at these remote sites.
80 days/year	Residential adult	Assume 2 days a week for 40 weeks, Snow cover for 10 weeks a year and a 2 week vacation.
280 days/year	Residential child 1-6 years-old	Assume 7 days a week for 42 weeks during the school year. Assume snow cover for 10 weeks a year. Assume a 2 week vacation.
124 day/year	Residential child 7-16 years-old	Assume 2 days a week for 24 weeks during the school year. Assume snow cover for 10 weeks a year. Assume 7 days a week for the 18 weeks when school is not in session. Assume a 2 week vacation.

Calculation of exposure dose from incidental ingestion of contaminated soil or sediment

The exposure dose formula for soil or sediment incidental ingestion used in this document is:

$$ed = c * ir * ef * af / bw \text{ , where}$$

ed = exposure dose; *c* = concentration in media of interest; *ir* = ingestion rate; *ef* = exposure factor; *af* = absorption factor; *bw* = body weight

The contaminant concentrations used "*c*" are the maximum amounts found in the samples, expressed in milligrams per kilogram (mg/kg).

The assumptions used for ingestion rate (*ir*) for residential exposures are:

Residential exposure - 2-6 year old child	Residential exposure - all other ages	Recreational exposure - all ages
0.0002 kg/day or 200 mg/day	0.0001 kg/day or 100 mg/day	0.0001 kg/day or 100 mg/day

The absorption factor (*af*) for lead in soil and foundry sand is assumed to be 0.3, or 30%. This is based on various studies. The actual lead absorption from these soils and foundry sand is unknown.

All other chemicals are assumed to be 100% absorbed.

The calculations are in Table 2.

Calculation of exposure dose from incidental ingestion of surface water

The exposure dose formula used in the surface water incidental ingestion assessment is:

$$ed = c * ir * ef * af / bw \text{ , where}$$

ed = exposure dose; *c* = concentration in media of interest; *ir* = ingestion rate; *ef* = exposure factor; *af* = absorption factor; *bw* = body weight

The contaminant concentrations used "*c*" are the maximum amounts found in the samples, expressed as milligrams per liter (mg/L).

The surface water ingestion rate (*ir*) is assumed to be 10 ml (or 0.01 Liter) a day for children and adults.

The absorption factor (*af*) is assumed to be 1, meaning 100% of the chemical is absorbed.

The calculations are in Table 3.

Calculation of exposure dose from pica behavior in soil

The exposure dose formula for pica behavior is the same as for soil or sediment incidental ingestion. Several assumptions were different. Pica behavior was assumed to occur in children 0.5 to 6 years-old. The body weight (*bw*) for this age range is 10 kilograms. The ingestion rate (*ir*) was 0.005 kilograms per day. The exposure factor (*ef*) is 0.12.

The calculations are in Table 4.

Calculation of estimated blood lead levels using the IEUBK model

Integrated Exposure Uptake Biokinetic Model (IEUBK) predicts the likelihood elevated blood lead levels will occur in children (under 7-years-old) based on exposure to environmental lead from many sources. The formula has four components exposure, uptake, biokinetic, and probability distribution.

The calculations used the model's basic assumptions about the amount of lead in outdoor air (0.1 µg/m^3), drinking water (4 µg/L), and diet (from 5.53 to 7.00 µg/day depending on age). The soil and dust intake rates ranged from 0.085 grams per day to 0.135 g/d. The model assumed indoor dust is composed of 70% dirt tracked from outside the home. The default ratios between the amount of lead in the air between outdoor and indoor air and between outdoor soil content and indoor dust were maintained. The soil and sediment lead content from test results in each area were used to calculate estimated blood lead levels.

No input from lead-based paint was included in the model.

The model can be found at: Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows® version (IEUBKwin v1 2002)
http://www.epa.gov/superfund/programs/lead/ieubk.htm.

Additional documentation about the method can be obtained from
http://www.epa.gov/superfund/programs/lead/products.htm#software.

Calculation of the risk of elevated blood lead levels in adults exposed to lead in soil

A different model was used for adults because adults and children are exposed to and absorb lead in different ways. Estimates of adult blood lead levels exposed to soils were calculated using a method recommended by the EPA [34]. The model used exposure to the average amount of lead in soil at *Area 1*, 3,218 mg/kg. An adult was assumed to be exposed to this soil for 80 days a year. EPA-recommended defaults were used for the biokinetic slope factor (0.4), intake rate of soil (0.05 grams per day), absolute gastrointestinal absorption factor (0.12), averaging time (365 days per year), and bioavailability factor (12%).

Time weighted averaging method for estimation of blood lead levels

A time weighted average for lead exposure was used to estimation the blood levels as follows:

The time weighted average = ([Part A] + [Part B])/365 days per year, where,

*Part A = (blood lead level estimated by the models from exposure to the soil or sediment containing lead) * (days per year in the area where exposures are assessed)*

*Part B = (blood lead level estimated by the models from exposure to lead at the residence as indicated by the background lead concentration) * ([365 days] – [days per year in the area where exposures are assessed])*

This method assumed exposures to soil lead for the days of the year indicated in Table 2. Lead exposure at home was estimated assuming a soil lead content of 32 mg/kg except for the *Arthur Road duplex.* Interior dust at the duplex was assumed be impacted by the 3,218 mg//kg lead in soil outside the home. Scenarios where significant lead-containing soils were tracked off site into children's homes were considered. Assumptions regarding residential dust concentrations are explained in the text.

APPENDIX D

Glossary

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Absorption factor
The amount of chemical likely to enter the body through the skin, lungs, or gastrointestinal track. (AF).

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Ambient
Surrounding (for example, ambient air).

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute

exposure and intermediate duration exposure]

cm/hour
centimeters per hour

cm^2
square centimeters

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Cancer Slope Factor
An estimate of the possible increases in cancer cases in a population, expressed in $(mg/kg/day)^{-1}$. Cancer slope factors are developed by the EPA.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental Media Evaluation Guide
Estimates of contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation. These are calculated for chronic, intermediate or acute exposure scenarios.

EPA
United States Environmental Protection Agency.

EPA Action Level
A concentration of a contaminant which, if exceeded, triggers treatment or other requirements which public water system must follow.

EPA National Secondary Drinking Water Standard
A guideline for a chemical in water that affects cosmetic (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

EPA Soil Screening Level
Estimates of contaminant concentrations not expected to result in noncarcinogenic health effects. This value takes into account the potential for the contaminant to migrate into groundwater.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are

in contact with.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Hazard
A source of potential harm from past, current, or future exposures.

HEAST
EPA Health Effects Assessment Summary Table

Health Outcome Data
Existing statistics that measure health outcomes or characterize the health status of a defined group of people.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Lifetime Health Advisory for Drinking Water
An amount of a chemical in drinking water that is not known or anticipated to cause noncarcinogenic health effects to persons exposed over a lifetime.

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/L
Milligram per liter.

mg/kg
Milligram per kilogram.

mg/kg/day
Milligram per kilogram per day.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

NCEA
The EPA National Center for Environmental Assessment.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppm
Parts per million.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community

concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public meeting
A public forum with community members for communication about a site.

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Reference Media Evaluation Guide
A concentration of a chemical in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. These are calculated for children and adults.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

μg/L
micrograms per liter

APPENDIX E

Response to Public Comments

The Agency for Toxic Substances and Disease Registry (ATSDR) issued a public health assessment draft for public comment on August 4, 2005 for the Reedsville Scattered Foundry Waste in Reedsville, Preston County, West Virginia. ATSDR received public comments between August 4, 2005 and October 21, 2005. The paraphrased comments and questions are presented (*in italics*) with ATSDR's response.

Comment: *We are personally aware of other lead sites not discussed in this report.*

ATSDR Response: Personal communication indicates the commenter knows of no additional areas than were discussed in the report.

Comment: C*ore sand was brought from the Morgantown facility to Reedsville.*

ATSDR Response: The report was modified to reflect this information.

Comment: *Rockwell Corporation volunteered to clean up this site (Area 10) and has not done so.*

ATSDR Response: EPA expected work in this area to begin in the spring of 2006.

Comment: *People and pets straying off the Rail-to-Trail risk their health from exposure to chemicals in the environment.*

ATSDR Response: *Area 10* is adjacent to the Rail-to-Trail. People and pets can get foundry sand on their shoes and feet while off the trail near *Area 10*. This sandy material is not likely to be tracked into people's homes. However, we considered a scenario where a child played 80 days a year at *Area 10* and tracked a significant amount of material home. This did not increase blood lead levels over 10 µg/dL.

Comment: *Do residents and visitors at Area 1 Arthurdale Road duplex know that they are on a dumping site? Are they aware that they can carry lead from the soil into their homes and vehicles? Former residents had small children that played in this soil and current residents have a dog. We believe that this site should have a warning sign posted to educate everyone coming near the site.*

ATSDR Response: A family with young children was relocated in the fall of 2001. No young children have resided here since then. A non-resident child would have to play in the soil at *Area 1* 80 days per year and track significant amounts of lead-containing material home before blood lead estimates were over 10µg/dL. Prudent public health practices that avoid tracking soil into the home, changing clothes and shoes after playing outside, washing children's toys are effective means to reduce exposures.

Comment: *Drinking water used at the Valley Elementary School needs to be placed on a scheduled testing regimen since the water is unfiltered and there is potential for future* *contamination. The test results should be available to the public.*

<u>ATSDR Response:</u> The public water system serving the school is required to sample water for various chemicals. Testing for lead is required. Test results are available for public review in the Environmental Engineering Division in the Office of Environmental Health Services, Bureau for Public Health.

<u>Comment:</u> *The dam on Ruby's Pond is unstable. The lead in the sediments will be disturbed should the water drain out of the pond. This is not addressed in the report.*

<u>ATSDR Response:</u> This potential risk cannot be estimated or modeled using currently available information.

<u>Comment:</u> *The amount of formaldehyde emitted into the air by the Fibair/Hollinee plant in previous years was not addressed in this report. The amount of formaldehyde they were putting in the air was incredible. There were many violations concerning water and air.*

<u>ATSDR Response:</u> The health assessment assessed potential health effects based on available environmental data. The assessment did not correlate the data to environmental violations.

<u>Comment:</u> *The cancer death rate in the community is very high near the Fibair/Hollinee plant. Formaldehyde is positively linked to cancer in humans.*

<u>ATSDR Response:</u> Nasopharyngeal cancer is the only cancer associated with exposures to formaldehyde. Preston County has a slightly higher rate of deaths from cancer than West Virginia as a whole (based on 1998-2002 five-year crude rates per 100,000 population).

<u>Comment:</u> *The report did not do enough to show the health damage done by the Fibair/Hollinee plant before the new regulations were put into effect. The number of illnesses in the community cannot be linked to the use of fingernail polish and breathing fumes from a few cars driving by, as the report states.*

<u>ATSDR Response:</u> The report reviewed available data and formaldehyde and methanol exposure estimates from 1980 to 2004. The illnesses and conditions associated with exposures to formaldehyde at this site are nasopharyngeal cancers and eye, nose and throat irritation as well as asthma in some people. No other illnesses are likely caused by exposures to formaldehyde or methanol. Formaldehyde in the community could not be attributed solely to emissions from the Fibair/Hollinee plant. A portion of the formaldehyde measured in town may have been from vehicle emissions.

<u>Comment:</u> *The formaldehyde testing that was referred to in the report is outdated and was proven later to be not factual.*

<u>ATSDR Response:</u> The commenter said formaldehyde measurements using hand-held devices occurred after significant reductions in emissions occurred. Therefore it did not reflect conditions prior to the reductions in emissions. The commenter said formaldehyde in the air during air inversions prior to reductions in emissions was not considered.

No data to evaluate this were available.

Comment: *The report should have cited information from the stack testing done at Hollinee.*

ATSDR Response: Emissions from the stack are related to, but are not, actual exposures. Formaldehyde levels measured in the community, reflective of actual exposures, were performed when emissions were similar to those measured during stack testing. Health effects were assessed using the ground level measurements.

Comment: *We request medical monitoring and a health study due to exposure to formaldehyde since the plant's opening. We feel the evidence is pointing to long-time exposure to formaldehyde when Hollinee was putting huge amounts in the air.*

ATSDR Response: The public health assessment estimated a potential risk for nasopharyngeal cancers of 16-48 in 10,000 from measured formaldehyde levels in Reedsville. This is considered a moderate risk for cancer. People concerned about formaldehyde exposures should ask their physicians if monitoring for nasopharyngeal cancers is advisable.

Comment: *Hollinee should be monitored by state and federal officials and the results made public.*

ATSDR Response: You can request information about the monitoring and results from the West Virginia Department of Environmental Protection in Charleston or the Environmental Protection Agency Region III offices in Wheeling.

Comment: *We believe that formaldehyde exposures are a larger danger than anyone ever thought (as cited a recent World Health Organization report).*

ATSDR Response: The commenter said the carcinogenic designation by the WHO was the important point. WHO's recommended air quality guideline is 100 $\mu g/m^3$ averaged over a 30 minute period to prevent irritated eyes and nose (sensory irritation) in the general population.

This report discussed the formaldehyde's ability to cause cancer. Information from the WHO was added to the report.