Health Consultation

8^{TH} AND PLUTUS STREETS POTTERY SITE
A/K/A TAYLOR, SMITH & TAYLOR POTTERY OR ROCK SPRINGS LEAD SITE

CHESTER, HANCOCK COUNTY, WEST VIRGINIA

EPA FACILITY ID: WVN000305784

OCTOBER 6, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

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Prepared by:

West Virginia Department of Health and Human Resources
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Foreword

This document summarizes public health concerns related to lead and PCB contaminated soil and sediment associated with the 8th and Plutus Streets Pottery site. People who could come into contact with these chemicals are schoolchildren, trespassers, and nearby residents.

A number of steps are necessary to complete this document.

Evaluating exposure: The West Virginia Department of Health and Human Resources ATSDR Cooperative Partners Program (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 the site, and how people might be exposed to it. The WVDHHR typically does not collect environmental samples. WVDHHR relies on information provided by the West Virginia Department of Environmental Protection (WVDEP), U.S. Environmental Protection Agency (EPA), and 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 that exposure could be harmful to human health. The report focuses on public health, or the health impact on the community as a whole. 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
ATSDR Cooperative Partners Program
West Virginia Department of Health and Human Services
Bureau for Public Health
Office of Environmental Health Services
Capitol and Washington Streets
1 Davis Square, Suite 200
Charleston, West Virginia 25301-1798

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Summary and statement of issues

The United States Environmental Protection Agency (EPA) requested this health consultation due to the amount of lead found at and near to this site and the proximity of schools and residential neighborhoods to this site.

The exposure pathways evaluated in this document are incidental ingestion of soil and sediment at or near the 8^{th} and Plutus Streets Pottery Site and pica by children living on site. Lead, arsenic, dieldrin, manganese, mercury, polynuclear aromatic hydrocarbons (PAHs), and Aroclor 1260 (a mixture of polychlorinated biphenyls or PCBs) were evaluated for possible health effects.

The review of possible health consequences found that children's exposures to lead in on-site soil could cause adverse health effects. These effects would be seen in children who live on–site who have the opportunity for regular contact with the soil or who have pica behavior.

The West Virginia Department of Health and Human Services (WVDHHR) performed this assessment under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Background

Site description and history

The 9.52 acre 8^{th} and Plutus Pottery Streets Site (the site) is located in a residential/light industrial neighborhood in Chester, Hancock County, West Virginia (Figure 1). Chester is located in the northern tip of West Virginia. The site is also known as the Taylor Smith & Taylor Pottery or the Rock Springs Lead site [1]. The designated address of the site is located at the intersection of 8^{th} and Phoenix Streets. The intersection of 8^{th} and Plutus Streets is located a block away from 8^{th} and Phoenix.

The site is an inactive pottery. Most of the buildings from the pottery are still standing. They include office buildings, material silos, the main pottery building, and warehouses. There is a gas well on the site. All surface drainage from this site flows into Marks Run and then into the Ohio River or directly into the Ohio River (Figure 2) [1].

Two former office buildings are rental properties. Families with young children have rented these apartments. The renters have access to the site through the rear doors of the apartments. The only recreational area for the apartments is on the site.

Residents indicate that trespassers have access to the site either through open gates along 8^{th} Street or by going over or through the fence. There is free access along portions of the west side of the property because the fence does not completely enclose the property. Graffiti and trails on-site indicate that trespassing occurs [2]. A local resident reported that organized activities, such as boxing matches, occur in a building on this site.

Pottery was manufactured at this site from 1900 until 1982. Due to the many changes in ownership during this time the facility has been known as Taylor, Smith, and Lee Pottery (1900-1907); Taylor, Smith, and Taylor Company (1907-1971) and Anchor Hocking Corporation (1971-1982). Hans Dietz bought the property in 1984. The property is currently owned by Rock Springs Enterprises. Another name for the site is the Rock Springs Lead site [1]. At one time DTC Tank Cleaning, a barge cleaning service, stored raw materials on-site [3].

The Ohio River forms the northern boundary of the site. The site is bordered to the northeast by a residential community that includes the Alicia Arms and the Hans Dietz Apartments. A light industrial and commercial area is near the southern boundary of the site. The Jennings Randolph Bridge, carrying U.S. Route 30, runs adjacent to the western portion of the site. An elementary school, playground, ball field, and library are about 0.2 mile west of the site, on the western side of the Jennings Randolph Bridge. A middle school is 0.25 mile southwest of the site. (Figure 1)

Playgrounds are located at the elementary school, middle school, the city park to the southwest of the site, and along 11th Street to the east of the site. All these playgrounds are within 0.5 mile of the site. A child day-care center operated for 5-6 years about 0.3 miles from the site to the southeast.

The drinking water source for the City of Chester and the surrounding area is from an infiltration gallery under the Ohio River. The infiltration gallery is upstream from the site and more than 100 feet under the Ohio River. The City of Chester operates this public water supply and supplies 3,422 people [4]. No other water intakes are known to be near this site on the West Virginia side of the Ohio River. No private wells are known to exist within 0.5 mile of this site.

The site is at an elevation of 700 feet. The soils in this area are the Berks-Allegheny-Monongahela Association. They are moderately deep, well-drained and are mostly very steep on the bluffs facing the Ohio River [5]. At one time the clay in these soils supported over 100 pottery plants in this area of West Virginia and Ohio.

Several large piles of broken pottery are located on the northwestern portion of the site, along the steep banks along the Ohio River and Marks Run. The piles extend off-site. This area is adjacent to a ravine. Marks Run, a stream that runs alongside and under the Jennings Randolph Bridge is in the ravine that separates the elementary school ball field from the pottery site. Human activity occurs in this ravine as evidenced by tire tracks, graffiti, and littering.

High levels of lead in soil have been found some places on this site while other on-site areas do not appear to be contaminated with lead. The source of lead currently on the property is assumed to be from glazes used on pottery. Pottery glazes used in the past often contained lead. The lead could have leached from the glazes and could be present in the soil and sediment in very small particles of glazed pottery. However, no studies have been done to determine if lead could have leached from the pottery glazes at this site.

The proximity of the ravine to the elementary school and the ballfield makes contact with lead-containing soils off the western edge of the property possible. Therefore, recreational exposure to the soil, sediment, and water in this area was considered for all ages, including young children.

The WVDEP found elevated levels of lead up to 158,000 milligrams per kilogram (mg/kg) in pieces of broken pottery in northwestern portion of this site near Marks Run. The EPA found elevated levels of lead, up to 30,300 mg/kg in the soil in this area.

The distribution and placement of the polychlorinated biphenyls (PCBs) in the soil indicate that oil spilled from transformers may have been the source of the PCBs found at this site. Two samples contained PCBs much higher than the other samples, indicating limited contamination of PCBs. One sample was taken along the southern edge of the property and the other was at the northern edge near the Ohio River.

Newell Rubbermaid, Inc., formerly Anchor Hocking Corporation, has agreed to mitigate or remove the lead and PCB contamination from the site, restrict public access to the contaminated areas, and perform an extent of contamination study. In addition, the corporation has agreed to restore and re-vegetate the excavated areas and control erosion on the hillsides at the site boundaries.

Site visit

WVDHHR and Hancock County Health Department representatives visited the area January 14, 2004. The site was viewed from the perimeter fence. Graffiti was observed on the former pottery buildings, indicating trespassing activity. Vegetation covered the ground in all areas visible during the site visit. The EPA reports that many areas on-site are not vegetated. The area under the Jennings Randolph Bridge is easily accessible from the ball field and elementary school playground. Steep slopes containing broken pottery were accessible in this area. The broken pottery was mixed with soil. The area was vegetated.

Demographics

Based on July 2002 United States Census data, approximately 2,500 people live in Chester. About 154 people live within 0.25 mile of this site and 570 people live within 0.5 mile of this site. There are 1,289 housing units in the city.

The median age of people living in Chester is 40.4. This is 5 years older than the median age of the population of the United States. Twenty percent of the population age is 65 years and older. Five percent of the population is under 5 years-old [6].

About 480 students attend the Allison Elementary School in Grades K-6. About 300 students in Grades 7-8 attend the Oak Glen Middle School. Both of these schools are within 0.25 mile of the site.

Senior citizens live in the Alicia Arms and Hans Dietz Apartments east of the site.

Community health concerns

Community members expressed various concerns during a January 2004 public meeting. The concerns are health effects from exposure to lead and other chemicals that might be on-site and release of asbestos during demolition of buildings. They are concerned that wind, water, and vermin are carrying the contaminants from the site into their community. They believe that there is a high cancer rate in the area.

Discussion

Data review and selection of chemicals of concern

Available environmental testing data in soil, sediment, and water on and near this site were reviewed.

The EPA took soil samples from on and off the site. Soil, sediment and surface water samples were taken. The samples were tested for 24 inorganic chemicals, 48 volatile chemicals, 65 semi-volatile chemicals, 21 pesticides, and 7 Aroclors (polychlorinated biphenyls). The EPA samples found lead in on-site soil up to 30,300 mg/kg. Off-site soil was found to contain lead up to 1,550 mg/kg [1].

The soil samples were selected from places that had a high potential for lead contamination. Therefore, averages of the lead in the soil samples used in this report are likely much higher than actual average lead content in the soil at this site. All soil samples reviewed were taken on or close to the surface of the ground (1-3 inches) where humans could contact the chemicals found in them.

Eight WVDEP samples of broken pottery were found to contain lead between 3,425 and 158,000 mg/kg. The average lead content of the pottery noted in these samples was 56,100 mg/kg. This data did not undergo complete data evaluation and were not used quantitatively [3].

A background sample was taken at the Lynn Murray library, about 0.25 mile southwest of the site. The library is near the elementary school and the ballfield. Lead was found in the soil at the library at 318 mg/kg. This is a higher amount that that found in soils in the Eastern United States [7]. Off-site residential soils were assumed to contain the amount of lead found at the library. It is possible that many off-site soils contain lead from this site or other former potteries.

The conclusions in this report are affected by the availability and reliability of the information that was reviewed. WVDHHR assumes that all EPA data used underwent adequate quality assurance and control measures during chain-of-custody, laboratory procedures and data reporting. Data that were noted as being possible laboratory contaminants or otherwise unreliable were not considered in this report.

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 based on an evaluation of toxicology literature for a given substance. They are used as screening tools. Many safety factors are included in the derivation of these values, making them very conservative (i.e., protective of public health). Exposure to a chemical below its corresponding CV indicates that adverse health effects are unlikely. Chemicals found above a CV *do not necessarily mean* that an adverse health effect will result. 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.

Chemicals were selected as chemicals of concern if test results indicated that the chemicals were in the environment in amounts above the selected CVs, if there were no established CVs for those chemicals, or if the chemicals were of particular concern to the community. The chemicals of concern selected for this site are listed in Table 1.

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),
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 or have been in contact with 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 that 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.) The amount of soil that people normally ingest from small particles of soil that cling to their hands is around 1/32 to 1/16 of a teaspoon a day. This is called incidental ingestion. Pica behavior is not common but will be considered in this report because of the potential for harm to children who ingest soil at this site. Children who eat soil via pica behavior ingest about one and on-half teaspoon of soil a day.
- Chemicals can get into the body through the skin. This is called dermal exposure.
- Chemicals can get into the body by breathing air containing chemical vapors or particles that are small enough to get into the part of the lung where they can be absorbed. This is called inhalation.

The source of lead contamination is assumed to be the glazes used in the pottery manufactured at this site. The source of the other metals found at the site i.e., arsenic, manganese, mercury, and nickel, may or may not be associated with the manufacturing of pottery. The source of the Aroclor 1260 may be limited spills of PCB-containing oil from transformers. Polynuclear aromatic hydrocarbons (PAHs) are associated with coal, coke, tar, and pitch. The source of PAHs on this site is unknown. Dieldren, a pesticide, was found in low amounts in two of the soil samples taken on site.

Completed pathways

Incidental ingestion of on-site soil – Residential exposure – completed pathway for the past, present, and future

Pottery glazes containing lead is assumed to be the source of the lead found in soil at this site. Broken pottery containing lead has been mixed in the soil at this site. Lead from this pottery has mixed with the soil, either from leaching from the pottery or the mixing of small particles of pottery in the soil. Areas where broken pottery is visible have the greatest lead content in the soil. The former office buildings on this property are rented to a family with young children and a young couple. The only play and recreational area for these apartments is behind the buildings, on-site. Residents have full access to the property from their back doors. Residents could be exposed to lead by incidental ingestion from the pottery when they play or work in these soils. Small children engage in more hand-to-mouth activities and are more likely to ingest contaminated soil this way. The incidental ingestion pathway is completed for on-site soil. This pathway existed in the past, is currently present, and will exist in the future until the amount of lead in the soil is significantly reduced.

Pica of on-site soil – Residential exposure – completed pathway for the past, present, and future

Pica behavior is the act of eating soil. It is estimated that between 4% and 21% of children have a tendency towards pica. Children who exhibit pica behavior are at increased risk from exposures to chemicals in the soil because they ingest more soil. We assumed that young children who live on-site would eat 5,000 milligrams of soil for 45 days a year over 6 years. This pathway is completed for the past, present, and future until the conditions at the site change.

Incidental ingestion of on-site soil – Non-residential (trespasser) exposure – completed pathway for the past, present, and future

Trespassing occurs on this site. Trespassers could be exposed to lead from the pottery when they play in these soils. The way that people could get chemicals from the soil into their bodies is through incidental ingestion. Although small children (ages 2-6) are more at risk of ingesting soil, it is assumed that it would be a rare occurrence for children of this age to trespass at this site. Small children were assumed to be trespassing on-site for only 17 days a year (as compared to small children who reside on-site who were assumed to be exposed to on-site soil 240 days a year). Young children who do not live on the site are most likely to access site-associated chemicals along the western portion of the site, near Mark’s Run. The incidental ingestion pathway for trespassers is completed for on-site soil. This pathway existed in the past, is currently present, and will exist in the future until the amount of lead in the soil is significantly reduced.

Incidental ingestion of off-site soil – Residential and non-residential exposure – completed pathway for the past, present and future

The lead at this site is assumed to be from the lead from the pottery that has leached and mixed with the soil off-site, primarily along the western edge of the site along the steep banks along Marks Run and the Ohio River. Portions of these banks are off-site. Sampling done near the 8th street entrance to the site in the residential area to the east of the site showed elevated levels of lead. People could be exposed to lead from the pottery when they work or play in these soils via hand-to-mouth activities. The incidental ingestion pathway is completed for on-site and off-site soil for residential and non-residential users. This pathway existed in the past, is currently present, and will exist in the future until the amount of lead in the soil is significantly reduced.

Incidental ingestion of residue from broken pottery on and off-site – Residential and non-residential exposure - completed pathway for the past, present, and future

Broken pottery at this site contains high levels of lead. Broken pottery is visible and accessible both on and off-site. People could be exposed to lead from the pottery when they play in these areas or take pottery to their homes. The way that people could get chemicals from the pottery into their bodies is through incidental ingestion of residue from the pottery. The incidental ingestion pathway is completed for broken pottery. This pathway existed in the past, is currently present, and will exist in the future until the amount of lead in the soil or lead-contaminated pottery at the surface of the site is significantly reduced.

Incidental ingestion of off-site sediment - Recreational exposure – completed pathway for the past, present and future

Arsenic, lead, and mercury were found in the sediment of Marks Run. People could be exposed to these chemicals during recreational activities in this stream. The assumption was that these chemicals were present in the past in at least the concentrations found at present. The chemicals are likely to be present in the future until site conditions change. Therefore, this is a completed pathway for the past, present, and future.

Eliminated pathways

Incidental ingestion of off-site surface water – Recreational exposure – eliminated pathway for the past, present and future

Lead was found in the water of Marks Run at levels below the criteria to be considered as a chemical of concern. People would not be exposed to enough of the chemical to be likely to cause adverse health effects. Therefore, this is an eliminated pathway for the past, present, and future.

Inhalation exposure to air-borne soils – eliminated pathway for the past, present, and future.

People can be exposed to chemicals in the air from chemicals that are gases or from chemicals that are on particles that are so small that they can reach the part of the lung where chemicals can be absorbed. Chemicals associated with this site are not likely to be in the air because they do not readily evaporate. Soils found to contain high levels of lead were in areas that have plants growing on them. Plants break the force of the wind at ground level, hold the soil particles, and keep the soil relatively moist. Soil that is vegetated is not likely to have wind move the soil particles into the air. Therefore, the exposure to chemicals in the air from this site is highly unlikely. This pathway is eliminated for the past, present, and future.

Dermal exposure to soil, sediment and surface water – eliminated pathway for the past, present, and future.

Chemicals are absorbed through the skin at different rates. Metals found are not easily absorbed through the skin, but polynuclear aromatic hydrocarbons (PAHs) are more readily absorbed. The concentrations of metals, PCBs, and PAHs found in soils and sediment at and near this site are not great enough to cause a significant amount of these chemicals to enter a person’s body when they are in contact with the skin. The assumption was made that the amount of chemicals found in these media in the past were not significant enough to cause dermal toxicity. No source of chemicals is likely to cause significant elevations of chemicals in these media in the future. Therefore, exposure to chemicals at this site at levels likely to be significant through the dermal route from the soil, sediment and surface water through dermal exposure is highly unlikely. This pathway is eliminated for the past, present, and future.

Exposure analysis

The methods for estimating exposure doses and blood lead levels are outlined in Appendix C. The exposure doses and blood lead levels are found in Tables 2-4 in Appendix B.

Selection of chemicals to be reviewed for noncarcinogenic effects

ATSDR minimal risk levels (MRLs) and EPA reference doses (RfDs) are examples of health-based comparison values that are protective of public health. These are values below which exposures would not be expected to cause adverse health effects. When estimated exposure doses were below these health-based comparison values, the chemical of concern was eliminated from further review. This means that 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 comparison value (CV), or for which there was no health-based comparison value, were selected for further review. Except that, no exposure doses were calculated for PAHs in off-site soil near Marks Run or off-site soil near the apartments because they were found at levels below background levels. The comparisons of estimated exposure doses and the CVs are outlined in Tables 2 and 3. The review for possible adverse health effects is accomplished by comparing the estimated exposure doses for these chemicals to research such as that outlined in the ATSDR toxicological profiles. The research reviewed indicates possible health effects from chemical exposure in particular amounts. The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals is called 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).

Additionally, all estimates of blood lead levels over 10 μg/dL were reviewed for possible adverse health effects.

Selection of chemicals to be reviewed for carcinogenic effects

Because cancers can develop over many years, past cancer risks based on current environmental sampling results are difficult to specify. No data for past exposures are available; therefore, the theoretical cancer risks were calculated based on current environmental data. WVDHHR calculated a theoretical excess cancer risk for all those chemicals of concern where the EPA has calculated a Cancer Slope Factor (CSF).

Possible health consequences – toxicological and epidemiological assessment

The assumptions used for the incidental ingestion pathways would require a persistent pattern of ingesting water, soil or sediment (Tables 2 and 3). The estimated exposure doses, therefore, are expected to be higher than would likely occur to any person at this site.

Chemicals selected for further review

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

- Lead, mercury, total PAHs, PCB’s (Aroclor 1260) in on-site soil from exposure via incidental ingestion and lead in soil found near Marks’ Run and the Alicia Arms Apartments.

- Lead, cadmium, manganese, mercury, nickel, total PAHs, PCB's (Aroclor 1260) in on-site soil from pica behavior.

This review determined that of these chemicals only lead had the potential for causing serious adverse health effects. These effects would be seen in children who live on –site and who have the opportunity to have regular contact with the soil. Contact would be from incidental ingestion or pica behavior. A theoretical excess cancer risk of 18 in 10,000 was estimated for pica exposures to total PAHs at this site. This estimate is in the low to moderate range and is likely much less.

Lead

Lead is a naturally occurring metal. Lead can be found in all parts of the environment. Lead is used in the production of batteries, ammunition, solder, and pipes. In the past, lead has been added to household paint, gasoline and was a component of glazes for ceramic pottery. Pottery glazes are the apparent source of the lead at this site.

Exposures to lead are most dangerous to young children and unborn children. Adults can be exposed to more lead without experiencing adverse health effects. The CDC level of concern for blood lead in children is 10 µg/dL. One of the reasons that the CDC sets this limit is because there are no effective clinical interventions that lower blood lead levels in children below this level [8].

The on-site soil samples were taken from areas that appeared to have been contaminated by pottery and were not randomly selected. Therefore, the use of the average amount of lead found in the samples likely overestimates the exposure doses and blood lead levels resulting from exposure to soil on-site.

The IEUBK Model was used to estimate blood lead concentrations in children (ages 0.5-7) exposed to soils through incidental ingestion. A time-weighted averaging method was used to derive blood lead level estimates based on the number of days children were assumed to be exposed to the soil. We estimated blood lead levels from 14.8 to 22.5 µg/dL for children 0.5 – 7 years-old living on-site who were exposed to the average amount of lead found in the on-site soil (4,782 mg/kg) for 240 days a year (Table 4). Note that the values calculated for this scenario were outside of the validated range of the model. However, these estimates correspond with estimated exposure doses of 0.0003 to 0.013 mg/kg/day found in Table 2.

No other exposure estimates for children, trespassers, or adults were found to raise the blood lead level over 10µg/dL. These exposures to lead in soil or sediment are not expected to have resulted in significant adverse health effects.

Children living on site and exposed to soil through incidental ingestion behavior are at increased risk of developing:

- Lowered intelligence and impaired motor development as found by Dietrich et al. in 1993.
- Reduced ability to work with numbers and words (Fulton et al. 1987)
- Growth that occurs slower than normal (Schwartz et al. 1986)
- Less ability to pay attention to the tasks at hand and hyperactivity (Silva et al. 1988)

- Nerve damage, including hearing loss (Holdstein et al. 1986)

The review of possible health consequences from pica exposure to lead is based on the estimated exposure dose found in Table 3. The estimated dose was used because the IEUBK Model cannot be used to estimate blood lead concentrations from pica behavior. We estimated that a child 0.5 – 6 years old exposed to lead in soil near the offices via pica behavior for 45 days a year would ingest lead at a rate of 0.035 mg/kg/day. This estimated exposure dose was compared to studies by Cools et al. (1976) and Stuik (1974) who found decreases in heme synthesis in men who were exposed to similar amounts of lead over a short period of time. A decrease in heme synthesis has several health effects, including reduced hemoglobin in the blood and impaired development of the nervous system. Children who are exposed to soil near the offices under pica conditions could experience similar health effects.

Some researchers believe, however, that *any* elevation of blood lead levels 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) [9].

The significant amount of lead in the pottery makes adverse health effects from exposure to lead in this material likely if these materials are handled on a routine basis. However, the potential adverse health effects cannot be determined, because there is no method to estimate the intake rate or blood lead levels from these exposures [9].

The 11th Report on Carcinogens [10] listed lead and lead compounds as reasonably anticipated to cause cancer. Studies have found that workers in lead industries had a small increased incidence of cancer. 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 that were given extremely high doses of lead developed cancer. However, the cancer in animals may have been caused in ways that are not relevant to the lead exposures found at this site. Because of this ATSDR believes that there is inadequate evidenced to determine lead's carcinogenicity in humans under conditions found at this site.

Cadmium

Cadmium is a metal that is naturally found in the earth's crust. It has many uses in industry such as in pigments, batteries, metal coatings, and some metal alloys. The source of cadmium at this site is unknown.

The estimated exposure dose for a child 0.5-6 years-old exposed to the highest amount of cadmium in soil near the offices via pica behavior (7.6 mg/kg) for 45 days a year over a 6 year period was 0.00047 mg/kg/day.

This estimated exposure dose was compared to an exposure for pica behavior based on the dose likely to cause gastrointestinal effects. Nordberg et al. (1973) estimated that the dose to cause nausea and vomiting in people exposed to cadmium in food was 0.07 mg/kg [11].

The amount to cause gastrointestinal effects is more than 145 times greater than the estimated exposure dose for pica behavior. In addition, there are no reports in the literature that exposure to cadmium ingested in soil can cause gastrointestinal upsets. Therefore, no adverse health effects are likely to occur from exposure to cadmium in soil at this site.

Manganese

Manganese is naturally found in many rocks and is naturally found in soils up to 7,000 mg/kg [12]. The manganese at this site may be naturally occurring or a combination of natural and sources from past land use.

The body requires manganese for good health. It is used in the body to break down amino acids and produce energy. Most people naturally regulate the amount of manganese in their body by excreting more manganese in the feces when they ingest more than the body needs. In addition, not all manganese ingested is absorbed into the body. The amount of manganese that children absorb from soil is unknown. Some people believe that absorption is between three and five percent. Until the absorption amount determined, the amount of manganese exposure from soil ingestion cannot be determined with any certainty.

Assuming that 100% of the manganese in the soil was absorbed, the estimate of exposure from pica behavior, 0.099 mg/kg/day was compared to a study by Grant et al (1997). Grant determined a NOAEL of 22 mg/kg/day for reproductive and developmental effects in rats exposed to manganese orally [13]. A safety factor of 100 was applied to the NOAEL to account for extrapolation between rats and humans and for human variability. The modified NOAEL was found to be twice that of the estimated exposure dose. Therefore, no adverse health effects are likely from oral exposure to manganese in the soil at this site.

Mercury

Mercury is a naturally occurring metal that is present in many soils in West Virginia. Mercury is used in many products, such as thermometers, dental fillings, and batteries. Mercury is released into the air when coal is burned. The source of mercury at this site is unknown. Mercury was assumed to be inorganic because this is the most toxic form likely to be in soil.

The greatest estimated exposure dose for mercury, to a resident child ingesting small amounts of on-site soil containing an average of 6 mg/kg mercury 240 days a year was estimated to be 0.00005 mg/kg/day. The estimated exposure dose to children eating soil under pica conditions was 0.00003 mg/kg/day.

These estimated doses were compared to studies of rats fed inorganic mercury by the National Toxicology Program (1993). The NOAELs for acute (0.93 mg/kg/day) and chronic (1.9 mg/kg/day) effects were modified using a safety factor of 100 to extrapolate from animals to humans and to account for human variability. The estimated exposure doses were still more than 300 times less than these amounts [14]. Therefore, no adverse health effects are likely to children or adults from exposure to mercury in on-site soil.

Nickel

The amount of nickel found in on-site soils is within the range observed in soils in the eastern United States, up to 700 ppm [15]. The nickel found at this site may be naturally occurring or it may be from the industrial activity that took place at this site.

The estimated dose for children exposed to nickel in the soil near the offices through pica behavior was 0.003 mg/kg/day. This was compared to a study by Sunderman et al. (1988) who found that people drinking water containing nickel experienced vomiting, cramps, and diarrhea at 7.1 mg/kg/day nickel in water (the LOAEL) [15]. The estimated dose was less than this amount, even when applying a safety factor of 100 to account for the use of a LOAEL and human variability. Therefore, no adverse health effects are expected from children's exposure to nickel in on-site soil.

Polychlorinated biphenyls (Aroclor 1260)

Polychlorinated biphenyls (PCBs) are manmade chemicals that found in the environment even though they are no longer manufactured in the United States. C produced mixtures of PCBs used the trade name "Aroclor.". Aroclors were used in electrical equipment because they did not burn easily and were good insulators. The type of PCB found at this site is Aroclor 1260

The highest estimated exposure dose via incidental ingestion to on-site soil was 0.00001 mg/kg/day. This was for a child 1-6 years-old exposed 240 days a year to on-site soil containing 1.7 mg/kg Aroclor 1260. This was compared to various studies that show a NOAEL for reduced birth weight in monkeys at 0.007 mg/kg/day [16]. The estimated exposure dose was 7 times lower than this NOAEL, even when a safety factor of 100 was applied to the NOAEL to take into account human variability and extrapolation from animals to humans. It should be noted, however, that these studies used a different commercial PCB mixture than what was found at this site.

The estimated dose to a child who engaged in pica behavior in soil near the offices was 0.00004 mg/kg/day. This estimated dose was compared to acute oral exposures to Aroclor 1254 in rats. Carter (1984, 1985) determined a NOAEL of 0.5 mg/kg/day for effects on rat livers [16]. A safety factor of 100 was applied to this NOAEL. The estimated exposure dose was 125 times less than the modified NOAEL.

Based on this information, no adverse health effects are likely from oral exposures to PCBs in the soil at this site

Polynuclear aromatic hydrocarbons (PAHs)

Polynuclear aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during incomplete burning of coal, oil, gas, garbage, or other organic substances such as tobacco smoke or charbroiled meat. PAHs are usually found as mixtures. A mixture of PAHs were associated with this site; acenapthylene, phenanthrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h)perylene. These chemicals were considered together, as total PAHs.

The highest exposure dose estimated for exposure to PAHs from incidental ingestion of on-site soil was estimated to be 0.0004 mg/kg/day for a child 1-6 years-old exposed to on-site soil. The contact time was assumed to be 240 days a year over a 5 year period. The estimated dose was more than 1000 times less than that found to show adverse health effects in mice when exposed between 15 and 365 days to fluoranthene and fluorene [17].

The estimated exposure dose for children who exhibit pica behavior on-site is 0.003 mg/kg/day. This estimate was found to be more than 1000 times less than Mackenzie et al (1981) found at a NOAEL level (10 mg/kg/day) for developmental effects in mice benzo(a)pyrene [17].

Therefore, no noncarcinogenic adverse health effects are expected from exposure to PAHs in on and off-site soils through either incidental ingestion or pica exposures.

A theoretical excess cancer risk of 18 in 10,000 was estimated for pica exposures to total PAHs at this site. This estimate is in the low to moderate range and is likely much less.

Health outcome data

WVDHHR reviewed records from the Office of Maternal, Child and Family Health and the Radiation, Toxics, and Indoor Air Division from 1995 through 2004. During this time period, 15% of the 171 children screened (from 0-72 months-old) had blood lead levels equal to or over 10 µg/dL. When confirmatory tests were completed, only one of these children was found to have a blood lead level over 10 µg/dL. Follow up indicated that lead based paint in the home was found to be the likely source of this child's high blood lead level of 20 µg/dL.

Community health concerns

Could wind, water or vermin transport enough of the contamination from this site to nearby residential areas to cause health problems?

Based on the testing done and the exposure assumptions used, no adverse health effects are expected as a result of exposure to off-site soil, sediment, or surface water near this site. The potential for wind to transport contaminants off-site is considered low as long as the site remains vegetated. Water flows from this site into Mark's Run and the Ohio River. The chemicals found in this water were not in high enough concentrations to be likely to cause adverse health effects in children or adults exposed to the water or sediment of this stream. Vermin are not likely to transfer enough contaminants off-site to cause potential health effects, and current off-site samples indicate that this is the case.

Could asbestos cause health effects in the community when the buildings are demolished?

The site has not been assessed for asbestos. No opinion can be made without more data. However, an asbestos assessment will be required under West Virginia law before these buildings can be demolished. If asbestos is found it must be safely removed before demolition can occur.

Is there a high cancer rate in this area?

We are not able to make conclusions about relative rates of specific types of cancer in Chester. The number of people with a particular type of cancer is small enough in this city of 2,500 people that one or two additional (or fewer) cancers diagnosed in a year significantly affects the incidence rate. This means that the incidence rates for specific cancers for Chester vary widely from year to year due to the small numbers of people represented.

The median age of people in Chester is 40.4. A median age of 40.4 means the number of people younger than 40.4 is equal to the number of people older than 40.4. The median age in Chester is higher than the median age in West Virginia or the United States. We expect to find more people with cancer in an older population because age is one risk factor for this disease [18].

The rates of the most common types of cancer; colon & rectum, lung & bronchus, female breast, prostate, and urinary bladder in Hancock County are not statistically higher than those in West Virginia or in the United States. There is a higher rate of "all cancers" in Hancock County than in West Virginia as a whole. Rates are published as 5 year annual age-adjusted incidence rates for residents from 1997-2001. Incidence rates for Hancock County are the rate of newlydiagnosed cases of cancer during 1997 through 2001. Age-adjusted means that the numbers are adjusted as if the populations are the same age.

Child health considerations

The many differences between children and adults demand special consideration. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and often use hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are 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, for access to medical care, and for risk identification. This health consultation considered potential health effects to children to give adults need as much information as possible to make informed decisions regarding their children's health.

A child's unique exposure to lead containing soil, sediment, and water were considered at this site, because children are particularly sensitive to the effects of lead. Children living on-site and playing in the lead-contaminated soil on a regular basis have the potential for serious and long lasting health effects from these exposures.

Conclusions

ATSDR summarizes the conclusions of a health consultation in one of five conclusion categories. They are

- urgent public health hazard,
- public health hazard,
- indeterminate public health hazard,
- no apparent public health hazard, and
- no public health hazard.

The WVDHHR concludes that the 8th and Plutus site poses a *public health hazard* for the past, present, and future because of chronic exposure of children living on this site to lead in on-site soils. The review found that children's exposures to lead in on-site soil could cause adverse health effects. These effects would be seen in children who live on-site and who have the opportunity to have regular contact with the soil through incidental ingestion or pica behavior.

Routine handling of pottery pieces may be a significant source of lead through incidental ingestion of pottery residue left on the hands.

Potential health effects from lead exposure are lowered intelligence and impaired motor development, reduced ability to work with numbers and words, slow growth rates, less ability to pay attention to the tasks at hand and hyperactivity, and nerve damage including hearing loss.

Exposures to polynuclear aromatic hydrocarbons were estimated to cause an excess cancer risk of 18 in 10,000 for children who exhibited pica behavior in the soil near the offices. Due to the conservative assumptions made, there is a very good chance that the actual risk of cancer is much lower.

Recommendations

1. The parents of children living on-site should not allow them to play in the on-site soil on a regular basis and should wet-clean floors and other high contact surfaces in the home on a regular basis.
2. Children that are living on-site should have the level of lead in their blood tested.
3. The potentially responsible party for this site in cooperation with the EPA should mitigate the hazard from incidental ingestion of on-site soil to children by removing or covering the lead-containing soil.
4. Children should not play with pottery pieces from this site due to their high lead content.

Public health action plan

1. The WVDHHR will educate the families renting the apartments on-site about the hazards of lead exposure and recommend that they obtain blood lead tests for their children.
2. The WVDHHR will educate the community about the potential adverse health effects from incidental ingestion of on-site soil or playing with pottery pieces.
3. The WVDHHR will evaluate additional sampling results from this site as appropriate.
4. Newell Rubbermaid, Inc., will remove the lead and PCB contaminated soil from the site, restrict public access to the contaminated areas, and perform an extent of contamination study.

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Certification

The West Virginia Department of Health and Human Resources (WVDHHR) prepared this health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures in existence at the time the health consultation was initiated.

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Charisse J. Walcott
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Division of Health Assessment and Consultation (DHAC), ATSDR

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

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Roberta Erlwine
Section Chief, SPS, DHAC, ATSDR

Appendix A. Figures

Figure 1: Site Location Map

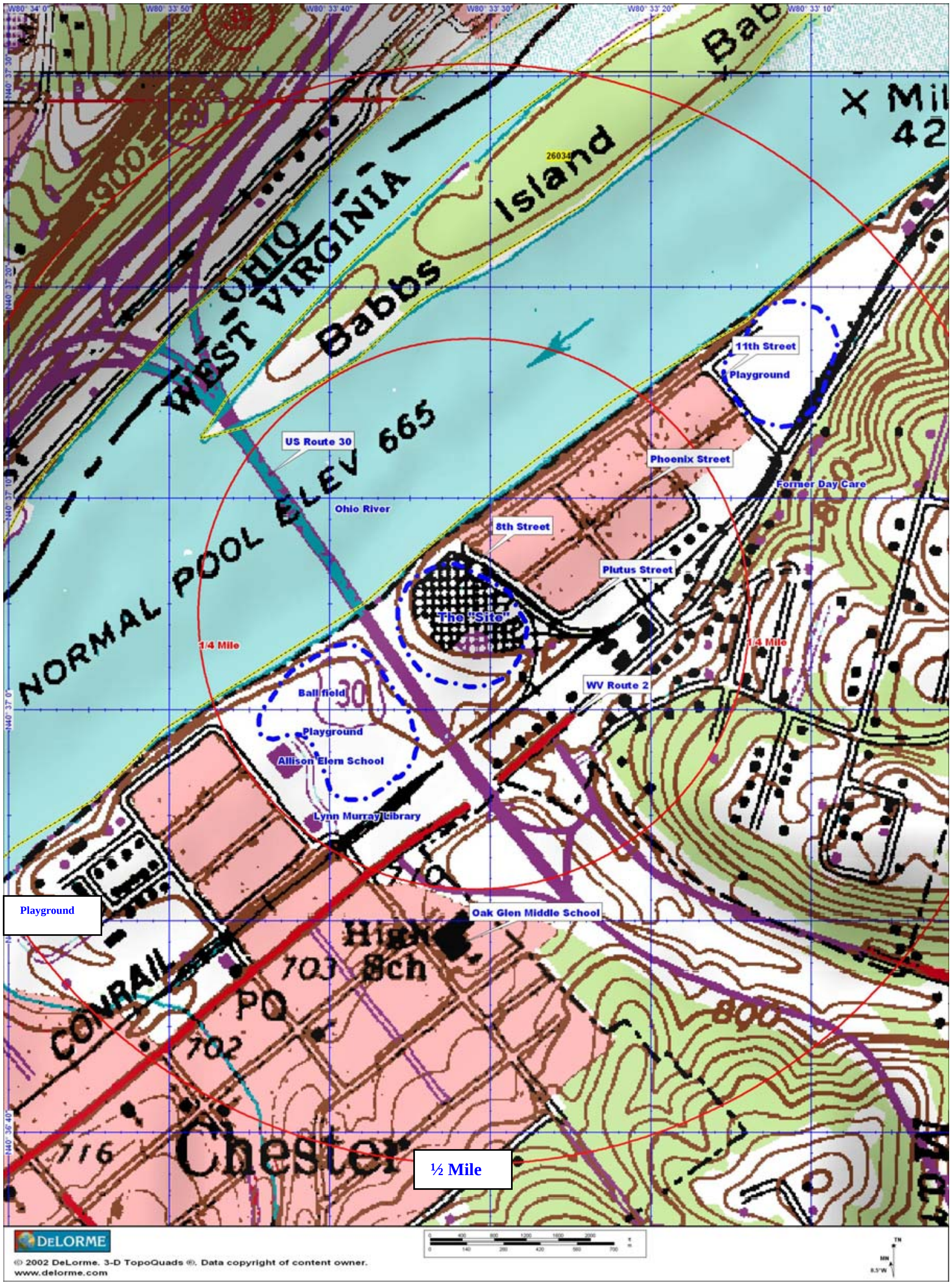
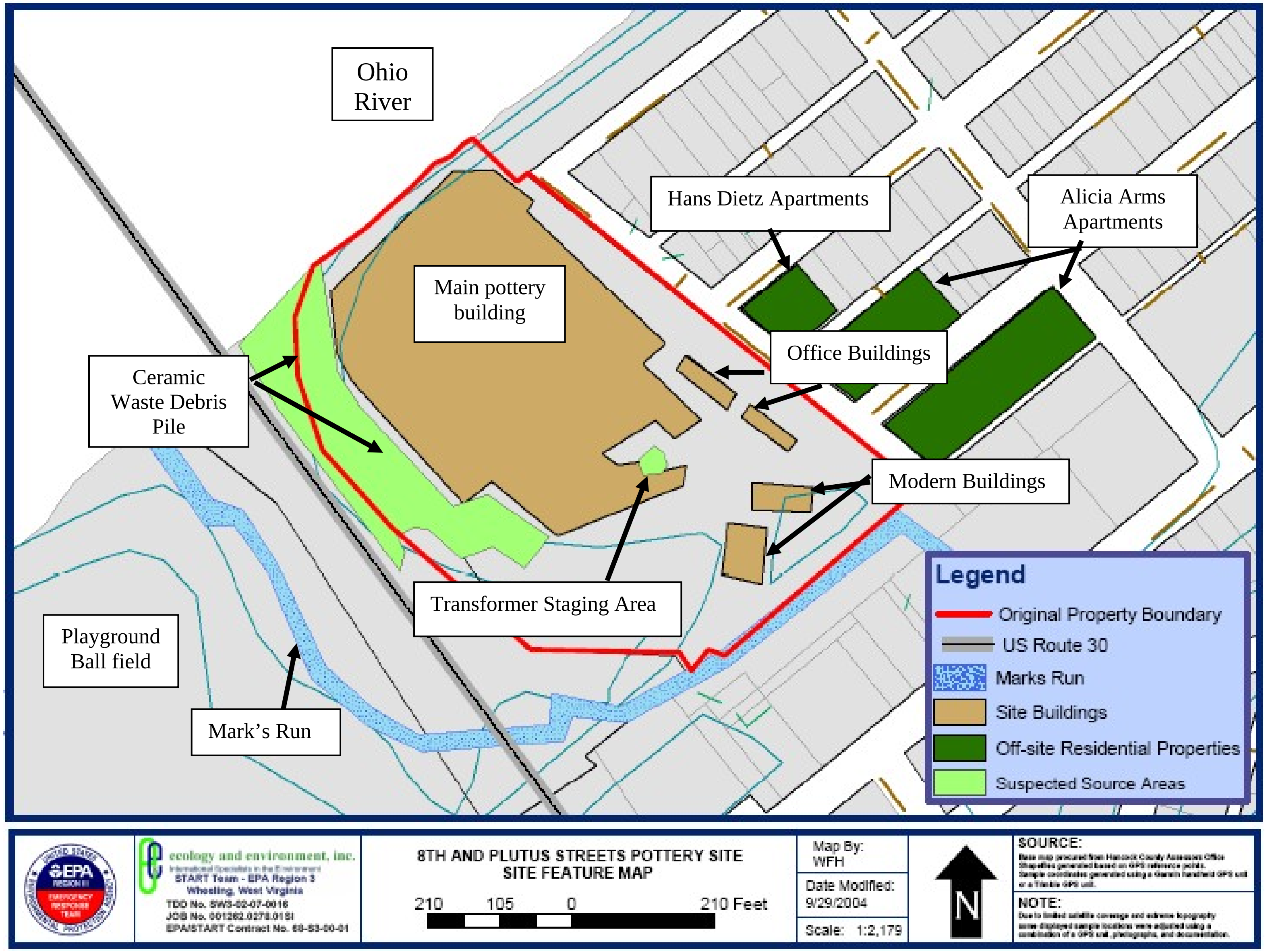


Figure 2: Site Map



Appendix B. Tables

Table 1: Contaminants of Concern in Soil and Sediment 8th and Plutus Pottery Site								
Contaminant	Number Samples	Number Detections	Range of concentrations measured over CV	Background	Environmental Guideline Comparison Values (CV)		Number detections greater than CV	Average of samples* mg/kg (ppm)
			mg/kg (ppm)	mg/kg (ppm)	mg/kg (ppm)	Type of CV		
SURFACE SOIL (on-site)								
Dieldrin	18	2	0.13		0.04	CREG	1	0.01
Aroclor 1260	18	12	0.68 - 21	0.058	0.4	CREG	4	1.7
Arsenic	27	26	5.0 - 86.5	12.7	0.5	CREG	27	21.8
Cadmium	27	26	11.0 - 62.6	0.87	10	Chron EMEG child	3	5.8
Copper	27	27	4,610	24.2	500	Int EMEG child	1	214
Lead	27	27	30.2 - 30,300	318		none	27	4,782
Manganese	27	27	13,100	712	3,000	RMEG child	1	1,073
Mercury	27	16	0.07 - 128	0.41		none	15	6
Nickel	27	27	1,220	8.3	1,000	RMEG child	1	75
Polynuclear Aromatic Hydrocarbons (PAHs)								
Acenaphthylene	11	6	0.047 - 1.9	0.16		none	6	
Phenanthrene	11	11	0.18 - 9.9	1.7		none	11	
Benzo(a)anthracene	11	11	2 - 9.6		0.87	RBC III resid soil	4	
Benzo(b)fluoranthene	11	11	1.4 - 6.4		0.87	RBC III resid soil	4	
Benzo(a)pyrene	11	11	0.17 - 10	1.9	0.1	CREG	10	
Indeno(1,2,3-cd)pyrene	11	9	3.7 - 4.5		0.87	RBC III resid soil	3	
Dibenzo(a,h)anthracene	11	6	0.098 - 2.0		0.087	RBC III resid soil	6	
Benzo(g,h)perylene	11	8	0.005 - 2.6	0.5		none	8	
SURFACE SOIL (off-site near Mark's Run)								
Arsenic	5	4	7.5 - 10.1	12.7	0.5	CREG	3	7.6
Lead	5	4	56.7 - 1,460	318	400	EPA SSL	3	530
Mercury	5	3	0.13 - 0.14	0.41		none	2	0.1

Table 1: Contaminants of Concern in Soil and Sediment 8th and Plutus Pottery Site								
Contaminant	Number Samples	Number Detections	Range of concentrations measured over CV	Background	Environmental Guideline Comparison Values (CV)		Number detections greater than CV	Average of samples* mg/kg (ppm)
			mg/kg (ppm)	mg/kg (ppm)	mg/kg (ppm)	Type of CV		
Polynuclear Aromatic Hydrocarbons (PAHs)								
Acenaphthylene	3	2	0.044 - 0.049	0.16		none	2	
Phenanthrene	3	3	0.29 - 0.56	1.7		none	3	
Benzo(a)pyrene	3	3	0.33 - 0.44	1.9	0.1	CREG	3	
Benzo(g,h)perylene	3	3	0.099 - 0.26	0.5		none	3	
SURFACE SOIL (off-site near apartments**)**								
Arsenic	4	2	6.4 - 29.9	12.7	0.5	CREG	2	10.1
Lead	4	2	118 - 1,550	318	400	EPA SSL	2	418
Polynuclear Aromatic Hydrocarbons (PAHs)								
Acenaphthylene	2	1	0.1	0.16		none	1	
Phenanthrene	2	1	0.53	1.7		none	1	
Benzo(b)fluoranthene	2	1	0.98		0.87	RBC III resid soil	1	
Benzo(a)pyrene	2	1	0.68	1.9	0.1	CREG	1	
Benzo(g,h)perylene	2	1	0.32	0.5		none	1	
SEDIMENT (off-site Marks Run)								
Arsenic	3	3	5.2 - 6.4	12.7	0.5	CREG	3	6.5
Lead	3	3	29 - 68.1	318	400	EPA SSL	3	42.4
Mercury	3	1	0.08	0.41		none	1	0.08
Polynuclear Aromatic Hydrocarbons (PAHs)								
Acenaphthylene	2	1	0.044	0.16		none	1	
Phenanthrene	2	1	0.29	1.7		none	1	
Benzo(a)pyrene	2	1	0.33	1.9	0.1	CREG	1	
Benzo(g,h)perylene	2	1	0.099	0.5		none	1	

Table 1: Contaminants of Concern in Soil and Sediment
8th and Plutus Pottery Site

Contaminant	Number Samples	Number Detections	Range of concentrations measured over CV	Background	Environmental Guideline Comparison Values (CV)		Number detections greater than CV	Average of samples* mg/kg (ppm)
			mg/kg (ppm)	mg/kg (ppm)	mg/kg (ppm)	Type of CV		

mg/kg = milligrams of contamiant per kilogram of soil or sediment (equivalent to parts per million or ppm)

µg/L = micrograms of contaminant per liter of water (equivalent ot parts per billion or ppb)

CREG = EPA Cancer Risk Evaluation Guide

EPA SSL = EPA Soil Screening Level

RBC III Resid Soil = EPA Region III Risk Based Concentrations for Residential soils

RMEG child = ATSDR Reference Media Evaluation Guide for a child

Int EMEG child = ATSDR Environmental Media Evaluation Guide for a child exposed for 15-365 days

Chron EMEG child = ATSDR Environmental Media Evaluation Guide for a child exposed over 365 days

EPA Action Level = the level at which a public water system would be required to take action if 10% of the samples exceeded this amount

* Average of samples were calculated assuming that all non-detections were equal to the detection limit

Source of Data: United States Environmental Protection Agency, Region III samples from June 2003.

Table 2: Estimated Exposure Doses and Cancer Risk for Incidental Ingestion of Soil and Sediment
8th and Plutus Pottery Site

Contaminant	Average Amount mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health based Guideline Comparison Values (CV)		Theoretical Excess Cancer Risk	
		Recreational exposures			Residential exposures			mg/kg/day	Type of CV	CSF	# in 10,000
		Child 2-6 years old	Child 7-16 years old	Adult over 16 years old	Child 1-6 years old	Child 7-16 years old	Adult over 16 years old				Recreational /Residential
SURFACE SOIL (on-site)											
Dieldrin (average)	0.01	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00005	ATSDR Chron Oral MRL	16	<1 / <1
Aroclor 1260 (PCB) (average)	1.7	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001		none	2	<1 / <1
Aroclor 1260 (PCB) (average near offices)	0.156	n/a	n/a	n/a	<0.00001	<0.00001	<0.00001		none	2	
Arsenic (average)	21.8	<0.00001	<0.00001	<0.00001	0.00005	<0.00001	<0.00001	0.0003	ATSDR Chron Oral MRL	1.5	<1 / <1
Arsenic (average near offices)	24.4	n/a	n/a	n/a	0.00005	<0.00001	<0.00001	0.0003	ATSDR Chron Oral MRL	1.5	<1 / <1
Cadmium (average)	5.8	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.001	EPA Chron Oral RfD		
Cadmium (average near offices)	1.8	n/a	n/a	n/a	<0.0001	<0.0001	<0.0001	0.001	EPA Chron Oral RfD		
Copper (average)	214	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	0.01	ATSDR Int Oral MRL		
Copper (average near offices)	33	n/a	n/a	n/a	<0.001	<0.001	<0.001	0.01	ATSDR Int Oral MRL		
Lead (average)	4,782	**0.00074**	**0.00044**	**0.00062**	**0.01258**	**0.00105**	**0.00034**		none		
Lead (average near offices)	908	n/a	n/a	n/a	**0.00239**	**0.00020**	**0.00006**		none		
Manganese (average)	1,073	0.001	<0.001	<0.001	0.009	0.001	<0.001	0.02	EPA Chron Oral RfD		
Managnese (average near offices)	620	n/a	n/a	n/a	0.005	<0.001	<0.001	0.02	EPA Chron Oral RfD		
Mercury (average)	6	<0.00001	<0.00001	<0.00001	**0.00005**	<0.00001	<0.00001		none		
Mercury (average near offices)	0.18	n/a	n/a	n/a	<0.00001	<0.00001	<0.00001		none		
Nickel (average)	75	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.02	EPA Chron Oral RfD	0.02	<1 / <1
Nickel (average near offices)	21	n/a	n/a	n/a	<0.001	<0.001	<0.001	0.02	EPA Chron Oral RfD	0.02	<1 / <1
Polynuclear Aromatic Hydrocarbons (PAHs) (all estimated doses calculated using the highest amount found on site)											
Acenaphthylene	1.9	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	<0.00001		none		
Phenanthrene	9.9	0.00001	<0.00001	<0.00001	0.00009	0.00001	<0.00001		none		
Benzo(a)anthracene	9.6	<0.00001	<0.00001	<0.00001	0.00008	0.00001	<0.00001		none	0.73*	
Benzo(b)fluoranthene	6.4	<0.00001	<0.00001	<0.00001	0.00006	<0.00001	<0.00001		none	0.73*	
Benzo(a)pyrene	10	0.00001	<0.00001	<0.00001	0.00009	0.00001	<0.00001		none	7.3	
Indeno(1,2,3-cd)pyrene	4.5	<0.00001	<0.00001	<0.00001	0.00004	<0.00001	<0.00001		none	0.73*	
Dibenzo(a,h)anthracene	2	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	<0.00001		none	7.3*	
Benzo(g,h)perylene	2.6	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	<0.00001		none		
Total PAHs	46.9	**0.00002**	**0.00001**	**0.00002**	**0.00041**	**0.00003**	**0.00001**		none	7.3	**1 / 3**

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

8th and Plutus Pottery Site

Contaminant	Average Amount mg/kg (ppm)	Estimated Exposure Doses from Incidental Ingestion (mg/kg/day)						Health based Guideline Comparison Values (CV)		Theoretical Excess Cancer Risk	
		Recreational exposures			Residential exposures					CSF	# in 10,000
		Child 2-6 years old	Child 7-16 years old	Adult over 16 years old	Child 1-6 years old	Child 7-16 years old	Adult over 16 years old	mg/kg/day	Type of CV		Recreational /Residential
SURFACE SOIL (off-site near Mark's Run)											
Arsenic (average)	7.6	<0.00001	<0.00001	<0.00001				0.0003	ATSDR Chron Oral MRL	1.5	<1 / <1
Lead (average)	530	**0.00008**	**0.00005**	**0.00007**					none		
Mercury (average)	0.1	<0.00001	<0.00001	<0.00001					none		
SURFACE SOIL (off-site near apartments**)**											
Arsenic (average)	10.1				0.00009	0.00001	<0.00001	0.0003	ATSDR Chron Oral MRL	1.5	<1 / <1
Lead (average)	418				**0.00110**	**0.00009**	**0.00003**		none		
SEDIMENT (Marks Run off-site)											
Arsenic (average)	6.5	<0.00001	<0.00001	<0.00001				0.0003	ATSDR Chron Oral MRL	1.5	<1 / <1
Lead (average)	42.4	**0.00001**	<0.00001	**0.00001**					none		
Mercury (average)	0.08	<0.00001	<0.00001	<0.00001					none		

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

mg/kg/day = milligram per kilogram per day

kg/day = kilograms per day

ATSDR Chron Oral MRL = ATSDR Chronic Oral Minimal Risk Level for exposures over 365 days

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

CSF = EPA Cancer Slope Factor ($mg/kg/day^{-1}$)

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	kg/day	0.0002	0.0001	0.0001	0.0002	0.0001	0.0001
Exposure frequency	days/year	17	50	50	240	120	100
	years	5	10	55	5	10	15
Body weight	kilograms	18	45	70	15	45	70
Absorption factors	Arsenic; 0.25		Lead in soil; 0.3		All other chemicals; 1		

Items in **bold** are reviewed further in the text

Table 3: Estimated Exposure Doses and Cancer Risk for Pica Behavior for Children living at this site
8th and Plutus Pottery Site

Contaminant	Maximum amount in soil near the offices	Estimated exposure dose	Health based Guideline Comparison Values (CV)		Theoretical Excess Cancer Risk	
	mg/kg (ppm)	mg/kg/day	mg/kg/day	Type of CV	CSF	# in 10,000
Aroclor 1260 (PCB)	0.68	**0.00004**		none	2	<1
Arsenic	45.7	0.0007	0.005	ATSDR Acute Oral MRL	1.5	1
Cadmium	7.6	0.00047				
Copper	55	0.003	0.01	ATSDR Acute Oral MRL		
Lead	1,880	**0.03477**		none		
Manganese	1,610	0.099				
Mercury	0.45	**0.00003**		none		
Nickel	41.6	0.003				
Polynuclear Aromatic Hydrocarbons (PAHs)						
Acenaphthylene	1.9	0.0001				
Phenanthrene	3.6	0.0002		none		
Benzo(a)anthracene	9.6	0.0006		none	0.73**	<1
Benzo(b)fluoranthene	14	0.0009		none	0.73**	1
Benzo(a)pyrene	10	0.0006	none	none	7.3	4
Indeno(1,2,3-cd)pyrene	4.5	0.0003		none	0.73**	<1
Dibenzo(a,h)anthracene	1.7	0.0001		none	7.3**	1
Benzo(g,h)perylene	2	0.0001		none		
Total PAHs*	47.3	**0.0029**			7.3	**18**

* Total of all PAHs that were analyzed. If the individual cancer risk factors were added together, the risk per 10,000 would be 6. If the CSF for the most carcinogenic PAH was used, for benzo(a)pyrene, the risk per 10,000 would be 18.

** CSF is an EPA Provisional Value
ppm = parts per million equivalent to mg/kg or milligrams per kilogram
mg/kg/day = milligram per kilogram per day
ATSDR Acute Oral MRL = ATSDR acute oral minimal risk level for exposures from 1 to 14 days
CSF = EPA Cancer Slope Factor (mg/kg/day^{-1})

Assumptions

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

Items in **bold** are reviewed further in the text

Absorption factors	Arsenic; 0.25	Lead in soil; 0.3	All other chemicals; 1

Table 4. Calcuation of blood lead levels of children exposed to lead-containing soils

8th and Plutus Site

Time Weighted Averages

Assume that residential exposures are at a soil lead level of 318 mg/kg (off-site background is 318 mg/kg)

	A	B	C	D	E	F	G	H
Calculation			AxB=C			DxE=F	C+F=G	G/365
Age Group	Blood level from exposure in the area*	Days per year in the area	Blood level times days	Blood level from exposure at the residence	Days per year at the residence	Blood level times days	Add blood level at both areas (to reflect 365 days a year)	Divide to 365 to get a time weighted average
	µg/dL			µg/dL				
SOIL ON SITE - incidental exposure to residential child AVERAGE SOIL LEAD CONTENT 4,782 mg/kg								
0.5-1	27.3	240	6,552	4.9	125	612.5	7,164.5	**19.6**
1-2	31.3	240	7,512	5.5	125	687.5	8,199.5	**22.5**
2-3	29.9	240	7,176	5.1	125	637.5	7,813.5	**21.4**
3-4	29.6	240	7,104	4.9	125	612.5	7,716.5	**21.1**
4-5	26.1	240	6,264	4.1	125	512.5	6,776.5	**18.6**
5-6	23	240	5,520	3.5	125	437.5	5,957.5	**16.3**
6-7	20.8	240	4,992	3.2	125	400	5,392.0	**14.8**
	NOTE: values over 30 are outside the range of validation of the method							
SOIL ON SITE - incidental exposure to residential child AVERAGE SOIL LEAD CONTENT NEAR OFFICES 908 mg/kg								
0.5-1	9.6	240	2,304	4.9	125	612.5	2,916.5	8.0
1-2	11.1	240	2,664	5.5	125	687.5	3,351.5	9.2
2-3	10.4	240	2,496	5.1	125	637.5	3,133.5	8.6
3-4	10	240	2,400	4.9	125	612.5	3,012.5	8.3
4-5	8.4	240	2,016	4.1	125	512.5	2,528.5	6.9
5-6	7.1	240	1,704	3.5	125	437.5	2,141.5	5.9
6-7	6.3	240	1,512	3.2	125	400	1,912.0	5.2
SOIL ON SITE - incidental ingestion exposure to recreational child AVERAGE SOIL LEAD CONTENT 4,782 mg/kg								
0.5-1	27.3	17	464.1	4.9	348	1,705.2	2,169.3	5.9
1-2	31.3	17	532.1	5.5	348	1,914.0	2,446.1	6.7
2-3	29.9	17	508.3	5.1	348	1,774.8	2,283.1	6.3
3-4	29.6	17	503.2	4.9	348	1,705.2	2,208.4	6.1
4-5	26.1	17	443.7	4.1	348	1,426.8	1,870.5	5.1
5-6	23	17	391	3.5	348	1,218.0	1,609.0	4.4
6-7	20.8	17	353.6	3.2	348	1,113.6	1,467.2	4.0
SOIL NEAR APARTMENTS - incidental exposure to residential child AVERAGE SOIL LEAD CONTENT 418 mg/kg								
0.5-1	5.8	240	1,392	4.9	125	612.5	2,004.5	5.5
1-2	6.5	240	1,560	5.5	125	687.5	2,247.5	6.2
2-3	6.1	240	1,464	5.1	125	637.5	2,101.5	5.8
3-4	5.8	240	1,392	4.9	125	612.5	2,004.5	5.5
4-5	4.9	240	1,176	4.1	125	512.5	1,688.5	4.6
5-6	4.2	240	1,008	3.5	125	437.5	1,445.5	4.0
6-7	3.7	240	888	3.2	125	400	1,288.0	3.5
SOIL NEAR MARK'S RUN - incidental exposure to recreational child AVERAGE SOIL LEAD CONTENT 530 mg/kg								
0.5-1	6.7	17	113.9	4.9	348	1,705.2	1,819.1	5.0
1-2	7.7	17	130.9	5.5	348	1,914.0	2,044.9	5.6
2-3	7.2	17	122.4	5.1	348	1,774.8	1,897.2	5.2
3-4	6.9	17	117.3	4.9	348	1,705.2	1,822.5	5.0
4-5	5.7	17	96.9	4.1	348	1,426.8	1,523.7	4.2
5-6	4.9	17	83.3	3.5	348	1,218.0	1,301.3	3.6
6-7	4.3	17	73.1	3.2	348	1,113.6	1,186.7	3.3

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 (IEUBK)*

Appendix C. Calculation of Estimated Exposure Doses and Cancer Risk

Calculation of exposure factors

The exposure factor is the time period that exposure to a non-cancer-causing chemical is assumed to occur divided by the total time during which the exposures occur. For instance, an exposure factor for a person exposed 50 days a year for 10 years would be 0.137. The formula used is:

$$\frac{\text{50 days per year (days of assumed exposure) } x \text{ 10 years (years of assumed exposure)}}{\text{365 days per year (total days in a year) } x \text{ 10 years (years of assumed exposure)}}$$

Exposures to cancer-causing chemicals are averaged over a 70-year lifetime. The formula for the exposure factor for a person exposed 50 days a year for 10 years would be 0.02. The formula used is:

$$\frac{\text{50 days per year (days of assumed exposure) } x \text{ 10 years (years of assumed exposure)}}{\text{365 days per year (total days in a year) } x \text{ 70 years (years assumed in a lifetime)}}$$

Absorption factors

Sometimes not all the chemical ingested gets absorbed into the body. Thirty percent of the lead in soil and 25% of the arsenic is assumed to be absorbed when it is ingested [19]. All other chemicals were assumed to be 100% absorbed.

Calculation of exposure doses for incidental ingestion and pica behavior

Estimated exposure doses for incidental ingestion or pica behavior (expressed as milligrams per kilogram per day or mg/kg/day) were calculated by multiplying

- the amount of media (surface water, sediment, or soil) ingested in a day by
- the amount of the chemical found in that media (maximum amount, or average amount where noted, from Table 1) by
- the absorption factor by
- the exposure factor, representing the amount of time over which the exposures occurred, and
- dividing all the above by the body weight of the person exposed.

These estimates are presented in Tables 2 and 3.

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

The EPA model for predicting blood lead levels in children under 7 years old was used to assess probable health effects from exposures to lead at this site. The name of the model is the Integrated Exposure Uptake Biokinetic Model (IEUBK). The formula has four components; exposure, uptake, biokinetic, and probability distribution.

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.

The model estimates the likelihood that a typical child will have certain blood lead concentrations based on exposures to lead in the environment. The model assumes that children will be exposed to lead from a variety of sources, outdoor soil, dust in the home, air, drinking water, and diet. The average amount of lead in on-site and off-site soils was used to calculate blood lead levels in children. The calculations used the EPA default assumptions about the amount of lead in outdoor air (0.1 micrograms per cubic meter or $\mu g/m^3$), drinking water (4 microgram per liter or µg/L), and diet (from 5.53 to 7.00 microgram per day or µg/day depending on age). The model assumes that high lead in the soil outside the home will result in high lead in the dust inside the home. The model does not estimate exposure to lead in soil under pica conditions or exposure to lead-based paint in homes [20].

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

Estimates of the blood lead level of adults exposed to on-site and off-site soils were determined using a method recommended by the EPA. The average amount of lead in the soil and the number of days per year a person was assumed to be exposed to the lead in the soil were the variables in the equation. The recommended default values used were; biokinetic slope factor (0.4), intake rate of soil (0.05 grams per day), absolute gastrointestinal absorption factor (0.12), and averaging time (365 days per year) [21].

Estimation of blood lead levels using time-weighted averaging

A time-weighted average was used to estimate blood lead levels. This method factors the time that people spend in contact with chemicals in soil with the time spent in the home or other areas not at the site. The amount of time at the area is from the assumptions in Table 2. The estimate of blood lead levels from exposures at home used the background level of 318 mg/kg of lead in the soil. The formula used is 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)*

*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])*

Calculation and estimation of risk of carcinogenic effects

Carcinogenic risks from exposure to chemicals with an EPA cancer slope factor (CSF) were calculated using the following procedure. The formulas are the same as that used for incidental ingestion and pica behavior but the exposure factor used is different, as explained in the "Exposure Factor Calculations" portion of this appendix.

Exposures for each age group are averaged over a 70-year lifetime. The estimate obtained for each age group is added together. This gives a theoretical excess cancer risk for a person that is exposed to the chemical over the total years noted in the exposure frequency assumptions in Table 2 and 3. This number was multiplied by the CSF (Tables 2 and 3).

The numbers obtained using this method are only estimates of risk because of the uncertainties and conservative assumptions made in calculating the CSFs. The actual risk of cancer is probably lower than the calculated number. The true risk is unknown and could be as low as zero. The method also assumes no safe level for exposure to a carcinogen. Lastly, the method computes the 95% upper bound region for the risk, rather than the average risk. This means that there is a very good chance that the risk of cancer 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.

Theoretical cancer risks below less than one in 10,000 were considered to be 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 were classified as a moderate risk, while greater than 99 in 10,000 are classified as a significant risk.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry
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Date October 14, 2005

From Division of Health Assessment and Consultation, ATSDR

Subject Health Consultation
8th and Plutus Streets Pottery Site

To Bucky Walters
Senior Regional Representative, ATSDR, Region III

Enclosed please find five copies of the October 6, 2005, Health Consultation on the following site prepared by the West Virginia Department of Health and Human Services under Cooperative Agreement with the Agency for Toxic Substances and Disease Registry.

8TH AND PLUTUS STREETS POTTERY SITE
CHESTER, HANCOCK COUNTY, WEST VIRGINIA
EPA FACILITY ID: WVN000305784

The Division of Health Assessment and Consultation requires copies of all letters used to transmit this document to the agencies, departments, or individuals on your distribution list. The copy letters will be placed into the administrative record for the site and serve as the official record of distribution for this health consultation.

Please address correspondence to the Agency for Toxic Substances and Disease Registry (ATSDR) Records Center, 1600 Clifton Road, NE (E60), Atlanta, Georgia 30333.

Aaron Borrelli
Manager, Records Center

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