Health Consultation

CSXT DEPRIEST SIGNAL SHOP

CITY OF SAVANNAH, CHATHAM COUNTY, GEORGIA

EPA FACILITY ID: GAD984307595

MARCH 18, 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:

Georgia Department of Human Resources
Division of Public Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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Summary

In the fall of 2003, the Georgia Environmental Protection Division requested that the Georgia Department of Human Resources, Division of Public Health, address health issues associated with exposure to contaminated soil at East Broad Street Elementary School and Matilda Park originating from historical operations at the CSXT DePriest Signal Shop in Savannah, Georgia. The CSXT facility is a former railroad freight and passenger transportation and locomotive repair operation. It is currently used to repair and store rail signal devices.

In May 2002, an environmental investigation was conducted for the CSXT property. Several contaminants were found in on-site and off-site soil. The focus of the investigation then shifted from CSXT to offsite properties because of their functions as a school and a public park, and the potential for children to be exposed to contaminated soil. Soil sampling found several contaminants above levels of health concern in some areas at the school and park.

In October 2003, in response to community requests, the Chatham County Commission closed Matilda Park. The Chatham County Health Department offered free blood lead level screenings to residents. Approximately 200 individuals were tested, and no elevated blood lead levels were found. Remedial activities were performed at the school in December 2003 and over summer, 2004, and at Matilda Park beginning in August 2004. Site cleanup activities began in September 2004 and were completed at the end of October 2004.

This health consultation contains information about the extent of contaminated soil and conclusions about the health risks posed to the public. A health consultation is specifically designed to provide information about the public health implications of a specific site and to identify populations for which further health actions or health studies are needed. It is not intended to serve the purpose of or influence any other environmental investigation such as risk assessment or selection of remedial measures, or to address liability or other non-health issues.

GDPH has categorized this site as **no apparent public health hazard** because:

- based on past and most recent soil sampling results, children attending the school, as well as adults, local residents, and other children who access the school grounds or park were not in the past, nor are they currently, exposed to contaminated soil at levels that are likely to cause adverse health effects. Future exposure to contaminants at levels known to cause adverse health effects is not likely because the school and park have undergone remediation;
- data are available for all environmental media of concern to which people have been exposed; and,
- there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health.

To reduce the potential for exposure to contaminated on-site soil, the gap in the fence surrounding the CSXT site was repaired when Matilda Park was closed so that children could no longer trespass on the site. GDPH has no recommendations at this time. If additional data become available, the information will be reviewed by GDPH and appropriate actions will be taken. GDPH will also respond to all requests for information regarding health issues associated with the site.

Statement of Issues

The Georgia Division of Public Health (GDPH) received a request from the Georgia Environmental Protection Division (GEPD) to conduct a health consultation for the CSXT DePriest Signal Shop (CSXT) site in Savannah, Chatham County, Georgia [1]. Several residents living near CSXT have expressed concern about contamination found in soil at East Broad Street Elementary School (EBES) and Mother Matilda Beasley Park (MP), both of which are located adjacent to CSXT (Appendix A: Figures 1-3, and Appendix F: Photographs 1-9).

In response, GDPH reviewed residents' concerns, health outcome data, and environmental sampling data to assess whether exposure to contaminated soil has occurred, is occurring, and may occur at levels of health concern. The purpose of this health consultation is to evaluate whether soil contaminant levels at EBES and MP could represent a health hazard to children and others who access these properties.

Background

Site Description and History

CSXT is located at 641 E. Liberty Street in Savannah, Chatham County, Georgia. Residential neighborhoods and Hubert Middle School are located east of the site. MP and EBES are located west of, and adjacent to CSXT. Residential neighborhoods are located to the north and south of the site. The Savannah River is approximately one mile north of CSXT (Figure 1).

The CSXT property contains three buildings that make up the signal shop, a parking lot, and a vegetated yard. The property is fenced and a gated entrance to the site is guarded and locked after hours. There was a gap in the western fence bordering MP and children attending EBES use this gap as a shortcut route to and from school. However, when MP was closed in October 2003, this gap was repaired.

Historical site activities included passenger transport, freight transport, and locomotive repair facilities. By 1916 all passenger rail and transport related activities ceased. As of 1990, railroad maintenance, repair, and storage activities were discontinued. The signal shop is still operating to repair and store signals used by the railroad. Hazardous waste generated by operations is managed, stored and transported off-site in accordance with RCRA hazardous waste management regulations [2].

In September 1988, a portion of the land was purchased by the Chatham County Board of Education with plans to build schools and a park. The Board of Education hired consultants to conduct cleanup before construction of EBES began. Soil from areas with suspected contamination was removed and replaced with new soil [2], in 1988, before GEPD hazardous waste standards were created in 1994.

In May 2002, GEPD required an environmental investigation for the CSXT property. Soil sampling was conducted, and metals and volatile organic compounds were found on and off site. Because of the potential for children to be exposed to contaminated soil at the school and park, the focus of GEPD's investigation then shifted from CSXT to those offsite properties [3]. School officials closed the north courtyard of EBES in August 2003 to determine the extent of contamination. Extensive soil sampling was conducted at EBES and MP in May and December 2003, and several contaminants were detected at levels above potential health concern [2].

In December 2003, interim remedial activities were performed in the north courtyard of EBES (Figure 2). The resulting excavation was backfilled with dirt and compacted. Air monitoring for lead and arsenic was performed at strategic locations during soil excavation and backfill operations. Reported air monitoring results for lead and arsenic were below method detection levels [4]. In addition, wipe samples for lead and arsenic were collected from inside EBES. The concentrations of lead and arsenic in the wipe samples were also below method detection levels [4].

Further remediation activities began at EBES in May 2004, at the end of the school year, for the front of the school, the fenced playground, and the south courtyard (Figure 2). Remediation was completed in early August 2004, before the new school year started. Remediation of MP began in August 2004 and completed in early September (Figure 3). Post-remediation sampling verification, which will appear in the final Compliance Status Report, is expected in January 2005 will eliminate the potential for future exposure to contaminated soil in the EBES and MP.

The CSXT site is currently undergoing restoration (Appendix F: Photographs 5, 6, and 7). Restoration was completed in October 2004. During the remediation project, air monitoring was conducted to ensure that the work did not result in exposures considered to be harmful to students, teachers, and the community [5].

Natural Resources Use

Homes in the area, and for several miles in all directions, have been connected to the municipal water supply for many decades. Municipal water sources for the area are regularly monitored, and there is no evidence that site contaminants have contaminated groundwater [2]. Municipal drinking water for Savannah is derived from the upper Floridan aquifer (greater than 150 feet deep). Eleven deep drinking water wells exist within a three-mile radius of CSXT [2]. The deep wells are hydraulically separated from the surficial aquifer by several confining layers, and shallow groundwater from CSXT discharges to a storm water sewer [2]. Consequently, migration of site related contaminants in groundwater is not considered likely [2].

On May 8, 2002 and November 12, 2003, nine groundwater monitoring wells installed on CSXT property and downgradient of EBES and MP were sampled to evaluate potential groundwater impacts from site-related activities. Results indicate that groundwater in the area has not been impacted by a release of any site-related contaminants [5].

Because site-related contaminants have not been found in the groundwater underlying the facility, the GEPD will not require a groundwater monitoring plan for the site. However, soil sampling at CSXT will continue during the delineation and subsequent remediation of on-site soil contamination [David Reuland, Principal Environmental Specialist, Georgia Department of Natural Resources, Environmental Protection Division, personal communication, September 10, 2004].

The only surface water in the area is the Savannah River, which is approximately one mile north of CSXT, and considered to far away too be impacted by the site [2].

Demographics

The population within one mile of CSXT is approximately 17,790 people. Using 2000 U.S. Census data, the Agency for Toxic Substances and Disease Registry (ATSDR) calculated population information for individuals living within a 1-mile radius of CSXT (Figure 1).

Community Health Concerns

In October 2003, the community asked the Chatham County Commission to close Matilda Park. Initially, yellow hazardous material tape was placed at the entrance to the park, and then chain-link fencing was installed around the perimeter of MP. A local environmental activist group petitioned ATSDR for a public health assessment, and ATSDR responded in November 4, 2003 stating that GDPH would provide a written health consultation and conduct a health education needs assessment.

The Chatham County Health Department offered free blood lead level screening in response to community concerns about soil sample findings at MP and EBES. On November 5 and November 22, approximately 200 individuals were tested for blood lead levels. All blood lead level test results were below 10 micrograms of lead per deciliter of whole blood (µg/dL). For children under the age of six, the Centers for Disease Control and Prevention has set a level of concern for at 10 *u*g/dL. This means that children with lead levels equal to or greater than 10 *u*g/dL are considered to have an elevated lead level and require appropriate follow-up. An elevated lead level does not mean that a child will have health effects, especially if caught early, and the source of the lead exposure is removed [6]. There is no blood lead level health guideline for adults; however, since lead is much more toxic to young children, 10 *u*g/dL is also considered protective for adults.

In October 2003, a Community Advisory Council (CAC) was formed with representatives from Citizens for Environmental Justice and the Eastside Concerned Citizens Neighborhood Association, the Chatham County School Board, and other community residents. The function of the CAC was to represent resident's concerns to the school board and CSXT and take part in communicating the risks posed to children and other residents accessing these properties.

On November 13, 2003, a public meeting was held to present and discuss soil sampling activities and other site related concerns. Additional public meetings were held on January 8, March 25 and May 6, 2004. Staff from the Chatham County Health Department, GEPD, and GDPH attended each meeting to answer questions and address health-related concerns.

GDPH distributed an environmental health education needs assessment survey between October 2003 and January 2004 to formally collect and document community concerns about exposure to lead and arsenic in soil. The results of the needs assessment are detailed in the report, *Environmental Health Education Needs Assessment: CSXT DePriest Signal Shop, Savannah, Chatham County, Georgia*. The conclusions from the survey are listed below:

- Approximately 50% of survey participants are concerned about lead and arsenic contamination.
- Most of those participants whose children attend EBES are concerned about lead and arsenic contamination.
- The most popular methods for participants to receive information are from newspapers and fact sheets delivered to the home and at local events.

- The survey response rate of 7% indicates low community involvement at this site. Numerous attempts to solicit community involvement went unanswered and are indicative of this low participation rate. Therefore, at the present time, it is suggested that extensive or increased environmental health education be omitted/limited. If the need arises later, or environmental health education is requested, the need will be investigated/assessed at that time.

Discussion

Between July and December 2003, approximately 1,700 surface and subsurface soil samples were collected from the following locations (Figures 2 and 3):

- the playground, on the south side of the EBES building
- along the southeast side of the EBES property
- the property line between CSXT and EBES
- between the southwest side of the EBES building and East Broad Street
- the north and south courtyards of EBES property
- the MP property
- the Hubert Middle School property

Sampling was conducted systematically using a 25-foot grid throughout the sampling areas [2]. Surface soil grab samples were collected from 0 to 6 inches below ground surface (bgs), while subsurface soil grab samples were collected from greater than 6 inches bgs. Contractors for CSXT, GEPD and Chatham County conducted soil sampling.

Pathway Analysis

GDPH identifies pathways of human exposure by identifying environmental and human components that might lead to contact with contaminants in environmental media (e.g., air, soil, groundwater). A pathways analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those in which all five elements are present, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. GDPH regards people who come into contact with contamination as exposed. For example, people who reside in an area with contaminants in air, or who drink water known to be contaminated, or who work or play in contaminated soil are considered to be exposed to contamination. Potential exposure pathways are those for which exposure seems possible, but one or more of the elements is not clearly defined. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. However, key information regarding a potential pathway may not be available. It should be noted that the identification of an exposure pathway does not imply that health effects will occur. Exposures may, or may not be substantive. Thus, even if exposure has occurred, human health effects may not necessarily result [7].

GDPH reviewed the site's history, community concerns, and available environmental sampling data. Based on this review, GDPH identified an exposure pathway that warranted consideration. Each of the completed and potential exposure pathways identified for the CSXT site are discussed in the following sections.

Completed Exposure Pathways

Table1 identifies a completed exposure pathway for contaminated soil at the EBES playground and MP. However, the ground cover, soil conditions, a person's age, and outdoor activity play a role in determining what dose or amount of contaminants a person receives during exposure to contaminated soil.

Table 1. Completed Exposure Pathways

Pathway	Exposure Pathway Elements					Time
	Sources	Medium	Point of Exposure	Route of Exposure	Exposed Population	
Surface soil	Various: rail yard, historical land use, motor vehicles	Soil	Soil at school playground and park	Ingestion Inhalation Dermal	Residents and children who access areas	Past Present Future

Ingestion is defined as *direct ingestion* or actively and passively eating soil particles; and, *indirect ingestion*, or inhalation of dust particles that are then expelled from the respiratory tract and swallowed (ingested). However, it is important to note that the other routes of exposure; inhalation of very small particles and vapors into the lungs, and direct skin contact (dermal absorption), may contribute additional exposure to contaminants at this site, but are considered to be minimal and not of health concern.

Potential Exposure Pathways

Inaccessible areas

Certain areas of the EBES property are presumed to exceed the applicable CVs, but are not accessible and therefore cannot be excavated. These areas include the soil directly underneath the EBES building, and areas immediately adjacent to the building (concrete pads, building overhangs, and soils supporting the building foundation). These areas are defined as inaccessible; hence, there will be no direct exposure pathway [5].

Evaluation Process

For each environmental medium, in this case, soil; GDPH examines the types and concentrations of contaminants of concern (COCs). In preparing this document, GDPH used the ATSDR comparison values, and other agencies' reference values, to screen contaminants that may warrant further evaluation. Comparison values (CVs) are concentrations of contaminants that can reasonably (and conservatively) be regarded as harmless, assuming default conditions of exposure. The CVs generally include ample safety factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects. CVs and the evaluation process used in this document are described in more detail in Appendix B. GDPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route and frequency of exposure and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists.

The contaminants identified for the completed exposure pathway are discussed in the following sections and presented in Tables 2. Other contaminants not exceeding CVs were reviewed, but not selected for additional evaluation in this assessment. The tables also include the chemical-specific CVs, which GDPH considered in the selection process.

When a contaminant exceeds a CV, the toxicological evaluation presented requires a comparison of calculated site-specific exposure doses (e.g., amount of the contaminant believed to enter the body at the person's body weight for an estimated duration of time) with an appropriate health guideline. The health guidelines are health-protective values that have incorporated various safety factors to account for varying human susceptibility. These guidelines are developed using human exposure data when it is available and animal data when human exposure data is not available. Health guidelines used are ATSDR's Minimal Risk Levels (MRLs) and the U.S. Environmental Protection Agency's (EPA's) Reference Dose (RfDs). MRLs and RfDs are described in more detail in Appendix B. Usually little or no information is available for a site to know exactly how much exposure is actually occurring, so in some cases, health assessors assume worse case scenarios where someone received a maximum dose. In cases where there is extensive sampling, or isolated "hot spots" are statistically insignificant outliers, the average values over CVs are used. As a result, actual exposure is likely much less than the assumed exposure. In the event that the calculated, site-specific exposure dose for a chemical is greater than the established health guideline, it is then compared to exposure doses from individual studies documented in the scientific literature that have reported health effects. If a COC has been determined to be cancer causing (carcinogenic), a cancer risk is also estimated [7] (Appendix B).

Soil

Soil sampling conducted on site in August 2002 indicated the presence of several contaminants above CVs. An effort was made to delineate the extent to which regulated substances exceeded established background concentrations [5]. It must be noted, however, that the delineation was not completed because the focus of the environmental investigation turned to EBES and MP. The target population for exposure to elevated levels of contaminants in on-site soil is workers who accessed the contaminated areas frequently. Because this is an operating facility, workers who may have been exposed to contaminated soil are advised to contact the U.S. Occupational Safety and Health Administration if they have health concerns. A copy of this health consultation will be provided to CSXT with the recommendation that workers be informed of potential exposures. In addition, the potential for exposure does exist for family members and the public from workers transporting contaminant residues off-site on their bodies and clothing.

Off-site soil sampling took place between July and December 2003 to characterize the extent of contamination associated with releases to soil from the site. Samples were collected from approximately 700 locations throughout MP, 1000 locations at EBES, and four surface/subsurface soil background samples were collected from Hubert Middle School. Tables 2 and 3 present the location, range, and average for each contaminant found above a CV, as well as the lowest applicable CVs.

Table 2. Comparison Of Off-site Surface Soil Sample Results To Applicable Comparison Values For Ingestion

	Contaminant	Location	Number of samples	Number of detections greater than the CV	Range of concentrations measured at levels greater than the CV (ppm)	Average of concentrations measured at levels greater than the CV (ppm)	CV* (ppm)	Type of CV[1]
SURFACE SOIL	Arsenic	EBES	64	3	21 to 31	24	0.5	CREG
		MP	47	10	21 to 600	163		
	Cadmium	MP	17	2	10 and 16	13	10	$EMEG_{c}$
	Copper	EBES	46	6	90 to 450	183	40[2]	$EMEG_{pc}$
		MP	7	5	69 to 210	146		
	Lead	EBES	64	6	480 to 3,400	1,185	400[3]	PRG
		MP	47	7	400 to 1,000	549		
	Zinc	EBES	46	2	1,100 and 1,300	1,200	600[2]	$EMEG_{pc}$
		MP	7	1	1,300	NA		
	Benzo(a)pyrene	MP	7	3	1.8 to 13	6.6	0.1	CREG

[1] Based on chronic exposure unless otherwise indicated
EBES: East Broad Street Elementary School
MP: Matilda Park
$EMEG_{c}$: Environmental Media Evaluation Guide (child)
[2] Based on intermediate exposure
$EMEG_{pc}$: Environmental Media Evaluation Guide (pica[1] child)
[3] EPA residential soil lead screening value of 400 ppm. No CVs exist for lead at this time.
PRG: EPA Region 9 Preliminary Remedial Goal (residential soil)
NA: not applicable
CREG: Cancer Risk Evaluation Guide ($1x10^{-6}$ excess cancer risk)
* Source: ATSDR, Soil Comparison Values (expires 12/30/04)

[1] *Pica* is defined as a craving to eat nonfood items, such as dirt, paint chips, and clay. Sometimes children exhibit pica-related behavior, and dirt is the most commonly eaten non-food item. Pica is very rare, and usually does not occur for an extended period of time. Children with pica should be given special consideration at hazardous waste sites, and are potentially at greater risk for adverse health effects from exposure to contaminated soil.

Table 3. Comparison Of Off-site Subsurface Soil Sample Results To Applicable Comparison Values For Ingestion

	Contaminant	Location	Number of samples	Number of detections greater than the CV	Range of concentrations measured at levels greater than the CV (ppm)	Average of concentrations measured at levels greater than the CV (ppm)	CV* (ppm)	Type of CV[1]
SUBSURFACE SOIL	Arsenic	EBES	327	76	20 to 180	45	0.5	CREG
		MP	81	26	20 to 210	46		
	Antimony	EBES	77	2	54 and 100	77	20	$RMEG_c$
		MP	38	4	23 to 77	48		
	Cadmium	MP	39	1	41	NA	10[2]	$EMEG_c$
	Copper	EBES	75	47	66 to 5,100	298	40[2]	$EMEG_{pc}$
		MP	38	18	69 to 930	285		
	Lead	EBES	329	95	410 to 71,000	2,462	400[3]	PRG
		MP	84	16	430 to 3,700	1,504		
	Thallium	EBES	56	1	710	NA	5.2	PRG
	Zinc	EBES	75	16	630 to 2,100	986	600[2]	$EMEG_{pc}$
		MP	39	5	690 to 16,000	5618		
	Benzo(a)pyrene	EBES	50	1	3.8	NA	0.1	CREG
		MP	40	3	1.7 to 23	9.0		

[1] Based on chronic exposure unless otherwise indicated
EBES: East Broad Street Elementary School
MP: Matilda Park
[2] Based on intermediate exposure
$EMEG_c$: Environmental Media Evaluation Guide (child)
$RMEG_c$: Reference Dose Media Evaluation Guide (child)
NA: not applicable
$EMEG_{pc}$: Environmental Media Evaluation Guide (pica child)
[3] EPA residential soil lead screening value of 400 ppm. No CVs exist for lead at this time.
PRG: EPA Region 9 Preliminary Remedial Goal (residential soil)
CREG: Cancer Risk Evaluation Guide ($1x10^{-6}$ excess cancer risk)
* Source: ATSDR, Soil Comparison Values (expires 12/30/04)

Surface soil sampling results revealed of arsenic, copper, lead, and zinc found at both EBES and MP, and benzo(a)pyrene and cadmium found at MP at levels above CVs. Although numerous COCs exist, and the maximum concentrations are quite high, it must be noted that these maximum concentrations were found in isolated subsurface areas. The minimal and random frequency in which higher contaminant concentrations we found seem to reflect “hot spots”. For this reason the average concentration of levels found (over a CV) was used for exposure dose calculations. Based on estimated dose and cancer risk calculations, GDPH has selected arsenic, benzo(a)pyrene, cadmium, and lead as contaminants warranting further evaluation. Copper and zinc were not selected for further evaluation because estimated doses were orders of magnitude less than the MRL.

The results of subsurface soil sampling are included in this health consultation, but are not used to calculate estimated doses. Subsurface samples were generally taken between 1 to 4 feet bgs. Activities associated with play such as running, sliding, and general horseplay are not likely to expose subsurface soil at the depths where contaminants were found.

Based on EBES and MP soil sample results, exposures were evaluated to determine the likelihood of health effects. Adult, child, and children with pica exposure doses were calculated for the concentration of contaminants based on the average detected concentration above a CV in surface soil. Estimated doses relative to health guidelines are presented in Table 4.

Table 4. Calculated exposure doses from ingestion of contaminated surface soil found at each site compared to health guidelines

	Contaminant	Total estimated dose (mg/kg/day)	Health guideline* (mg/kg/day)	Numeric cancer risk*
EBES	Arsenic[1]	Adult: 1.7×10^{-6} Child: 1.5×10^{-5} Pica: 0.00034	MRL: 0.0003	2.6×10^{-6} 3.1×10^{-6} NA
EBES	Copper	Adult: 1.3×10^{-5} Child: 0.0001 Pica: 0.003	MRL: 0.02	NA
EBES	Lead	Adult: 8.5×10^{-5} Child: 0.0007 Pica: 0.02	not established	NA
EBES	Zinc	Adult: 8.6×10^{-5} Child: 0.00075 Pica: 0.02	MRL: 0.3	NA
MP	Arsenic[1]	Adult: 1.4×10^{-5} Child: 0.0001 Pica: 0.003	MRL: 0.0003	2.1×10^{-5} 2.6×10^{-5} NA
MP	Cadmium	Adult: 1.1×10^{-6} Child: 1.0×10^{-5} Pica: 0.0003	MRL: 0.0002	NA
MP	Copper	Adult: 1.25×10^{-5} Child: 0.0001 Pica: 0.003	MRL: 0.03	NA
MP	Lead	Adult: 4.7×10^{-5} Child: 0.0004 Pica: 0.01	not established	NA
MP	Zinc	Adult: 0.0001 Child: 0.001 Pica: 0.02	MRL: 0.3	NA
MP	Benzo(a)pyrene[1]	Adult: 5.7×10^{-7} Child: 5.0×10^{-6} Pica: 0.0001	not established	4.1×10^{-6} 5.1×10^{-6} NA

mg/kg/day: milligrams per kilogram per day
MRL: minimal risk level
NA: not applicable
[1] Based on EPA's cancer slope factors [arsenic: 1.5 $(mg/kg/day)^{-1}$, benzo(a)pyrene: 7.3 $(mg/kg/day)^{-1}$]
* Source: ATSDR, health guidelines (expires 12/30/04)

Toxicological Evaluation

Arsenic

The calculated exposure doses to arsenic for adults and children are well below the established health guideline of 0.0003 mg/kg/day. However, exposure dose to arsenic for children with *pica* is higher than established health guideline of 0.0003 mg/kg/day both at EBES and MP. The health guideline used is ATSDR's chronic oral MRL, which is based on a study conducted in Taiwan where a large number of poor farmers who were exposed to high levels of naturally occurring arsenic in well water. A control group used in the study showed no observed adverse health level (NOAEL) effects at 0.0008 mg/kg/day [8]. Because the difference between calculated exposure doses for adults and children and the exposure dose deemed to be a health-protective value is significant, GDPH concludes that non-carcinogenic adverse health effects from arsenic exposure at CSXT are not expected to result from current and future exposures. However, the exposure dose to arsenic for children with *pica* is higher than health guideline value. It should be noted that the incidence rate of deliberate soil ingestion behavior in the general population is low. On the basis of data from the five key studies, only one child out of more than 600 children involved in all of these studies ingested an amount of soil significantly greater than the range for other children [9]. Some studies showed that the incidence rate of *pica* behavior appears to be higher for black children than for white children, and higher among children in lower socioeconomic groups [9]. Demographic data shows that 64% of the population within one mile of CSXT is Black and 9.4% of the population is children aged 6 and younger (Figure 1). It must be noted, however, that within one mile of CSXT, approximately 3 children aged 6 and younger might exhibit pica behavior, which is 0.2% of all children aged 6 and younger in the area. Concentrations of soil arsenic that may have existed in the past are unknown. However, adverse health effects from past exposure to arsenic are not expected because current estimated exposure doses for adults and children are substantially below levels in which adverse health effects would likely occur.

Data used to develop the health guideline and assess carcinogenic effects of arsenic exposure are based on the ingestion of drinking water, not the ingestion of soil or food containing arsenic. The EPA classifies inorganic arsenic as a human carcinogen based on sufficient evidence from human data. Increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic [10].

The development of cancer can be related to one's lifestyle: such as cigarette smoking, heavy drinking, and diet (for example, excess calories, high fat, and low fiber). Other important cancer risk factors, in general, include reproductive patterns, sexual behavior, and sunlight exposure. A family history of cancer may also increase a person's chances of developing cancer. Numeric risks of contracting cancer estimated for individuals exposed to arsenic concentrations in the soil at EBES, based on estimated doses, are 2.5×10^{-6} (2.5 in 1 million) for adults, and 2.0×10^{-6} (2 in 1 million) for children. Numeric risks of contracting cancer estimated for individuals exposed to arsenic concentrations in the soil at MP, based on estimated doses, are 2.1×10^{-5} (2.1 in a 100 thousand) for adults, and 1.35×10^{-5} (1.35 in 100 thousand) for children. Adult numeric risks are based on a lifetime of exposure (70 years) and children's numeric risks are based on 6 years of childhood. The numeric risks at EBES are low for both children and adults. The numeric risks at MP are low to moderate for both children and adults. Furthermore, because of the nature of EBES and MP property use, prolonged exposure to site contaminants is unlikely, so the risk of contracting cancer from site related contaminants is likely to be further reduced.

Benzo(a)pyrene

An evaluation of the available benzo(a)pyrene soil data indicate that the calculated exposure dose is 5.7×10^{-7} (57 millionths) mg/kg/day for adults, 5.0×10^{-6} (5 millionths) mg/kg/day for children, and if a child exhibited *pica* characteristics, the estimated dose is 0.0001 mg/kg/day. A health guideline has not been established for benzo(a)pyrene, however, a NOAEL of approximately 200 mg/kg/day has been established for mice undergoing intermediate exposure to benzo(a)pyrene, when reproductive effects were evaluated [11]. Non-carcinogenic adverse health effects from soil ingestion are not expected to result from current and future exposure to soil at MP. Although concentrations of soil benzo(a)pyrene that may have existed in the past are unknown, adverse health effects from past exposure to benzo(a)pyrene are not likely because the likely site-specific exposure doses would be low.

The International Agency for Research on Cancer classifies benzo(a)pyrene as probably carcinogenic to humans (limited human evidence; sufficient evidence in animals). The EPA also classifies benzo(a)pyrene as a probable human carcinogen, while the NTP suggests that benzo(a)pyrene is reasonably anticipated to be a carcinogen. Human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking. There are, however, multiple animal studies in many species demonstrating benzo(a)pyrene to be carcinogenic following administration by numerous routes [12, 13, 14].

Numeric risks for contracting cancer estimated for individuals exposed to benzo(a)pyrene concentrations in the soil at CSXT, based on estimated doses, are 4.2×10^{-6} (4.2 in 1 million) for adults, and 6.75×10^{-7} (6.75 in 10 million) for children. Adult numeric risks are based on a lifetime of exposure (70 years) and children's numeric risks are based on 6 years of childhood. The numeric risks are insignificant for both children and low for adults. Furthermore, because of the nature of EBES and MP property use, prolonged exposure to site contaminants is unlikely, so the risk of contracting cancer from site related contaminants is likely to be further reduced.

Cadmium

An evaluation of the available cadmium soil data indicate that the calculated exposure dose is 1.1×10^{-6} (1.1 millionths) mg/kg/day for adults, 1.0×10^{-5} (1 hundred thousandths) mg/kg/day for children, and if a child exhibited *pica* characteristics, the estimated dose is 0.0003 mg/kg/day. Although, the calculated exposure doses to cadmium for adults and children are below the established health guideline of 0.0002 mg/kg/day, exposure dose to cadmium for children with *pica* is slightly higher than established health guideline. Children with *pica* behavior are at the greatest risk of adverse effects from exposure to cadmium, however, the incidence rate of deliberate soil ingestion behavior in the general population is low. Non-carcinogenic adverse health effects from soil ingestion are not expected to result from current and future exposure to cadmium at EBES and MP. Although concentrations of soil cadmium that may have existed in the past are unknown, adverse health effects from past exposure to cadmium are not likely because the likely site-specific exposure doses would be low.

The EPA classifies cadmium as a probable human carcinogen based on limited evidence from occupational epidemiologic studies. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. Seven studies in rats and mice wherein cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of carcinogenic response [15].

A 2-fold excess risk of lung cancer was observed in cadmium smelter workers. The cohort consisted of 602 white males who had been employed in production work a minimum of 6 months during the years 1940-1969. The population was followed to the end of 1978. Urine cadmium data available for 261 workers employed after 1960 suggested a highly exposed population. The authors were able to ascertain that the increased lung cancer risk was probably not due to the presence of arsenic or to smoking [16]. Because the Standardized Mortality Ratios (SMRs)[2] observed were low and there is a lack of clear cut evidence of a causal relationship of the cadmium exposure only, this study is considered to supply limited evidence of human carcinogenicity [15].

Excess lung cancer risk was also observed in three other studies, which were, however, compromised by the presence of other carcinogens (arsenic, smoking) in the exposure or by a small population [16, 17, 18]. Additionally, four other studies of workers exposed to cadmium dust or fumes provided evidence of a statistically significant positive association with prostate cancer, but the total number of cases was small in each study. Studies of human ingestion of cadmium are inadequate to assess carcinogenicity [15]. It must be noted, however, that human data for cadmium were obtained from occupational studies. At EBES and MP we are considering residents and persons who study, work, or play at the site area.

Lead

An evaluation of the available lead soil data indicate that the calculated exposure dose is 8.5×10^{-5} (8.5 hundred thousandths) mg/kg/day (EBES) and 4.7×10^{-5} (4.7 hundred thousandths) mg/kg/day (MP) for adults, 0.0007 mg/kg/day (EBES) and 0.0004 mg/kg/day (MP) for children, and if a child exhibited *pica* characteristics, the estimated dose is 0.02 (EBES) and 0.01 (MP) mg/kg/day.

EPA's residential soil lead screening value is 400 mg/kg. This value is derived from a model and is considered to be protective of health and the environment [19]. The Centers for Disease Control and Prevention (CDC) considers children to have an elevated blood lead level if the amount of lead in blood is 10 micrograms of lead per deciliter (µg/dL) of whole blood or greater [20] but, given our increasing scientific knowledge, the levels of lead thought to be associated with negative health effects have been dropping in recent years [20]. Because of the varied nature of lead-containing compounds, ATSDR has not developed a health-based comparison value for lead; however, ATSDR has developed a mathematical model designed to estimate blood lead levels in the body based upon the actual concentrations of lead in soil (Appendix C) [21].

A person's blood lead level is a good indicator of recent exposure to lead and correlates well with health effects. However, lead concentrations in soil do not directly predict adverse health effects. It is estimated that blood lead levels generally raise three to seven µg/dL for every l000 mg/kg increase in soil lead concentration [21]. It has been observed that residential soils with lead concentrations greater than 500 mg/kg have been associated with blood lead levels greater than 10 µg/dL in children 6 to 71 months of age [21]. Based on the results of applying soil lead concentration to the ATSDR lead model (Appendix C), we can conclude that elevated blood lead levels among persons exposed to lead from soil at EBES and MP are not expected. Furthermore, the results of blood lead level sampling conducted by the Chatham County Health Department confirmed that blood lead level test results were below 10 micrograms of lead per deciliter of whole blood (µg/dL)

[2] SMR: Observed # deaths per year / Expected # of deaths per year (for example, SMR of 1.00 means that the observed rate equals the expected rate, etc.)

Child Health Considerations

To ensure that the health of the nation's children is protected, ATSDR has implemented an initiative to protect children from exposure to hazardous substances. In communities faced with air, water, soil, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in 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. A child's lower body weight and higher intake rate results in a greater dose of hazardous 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. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

At EBES and MP, children have been, and may currently be exposed to contaminated soil until post remediation sampling verifies successful remediation. Parents with young children should exercise caution and implement interim measures to limit their child's exposure to contaminants in soil and other possible sources, including their home. See Appendix G for interim steps one can take to reduce exposure to lead and arsenic in soil and other sources. Also, parents should ensure that children playing outside don't bring soil into the house on their shoes, toys, or pets [19].

Conclusions

GDPH developed the following conclusions and assigned a public health hazard category to the site. A description of public health hazard categories is provided in Appendix D.

Based on the data evaluated, GDPH considers this site to pose **no apparent public health hazard**. Specifically:

- The calculated exposure doses for arsenic, cadmium, lead and benzo(a)pyrene present in the soil at EBES and MP are substantially lower than respective exposure doses known to be associated with adverse health effects; adverse health effects from ingestion, dermal contact, and inhalation are not expected to result from past, current, and future exposure to levels of these contaminants found in soil at EBES and MP. Children exhibiting *pica* characteristics may be a concern, because intentional ingestion of contaminated soil can increase exposure dose. Nonetheless, the incidence rate of deliberate soil ingestion behavior in the general population is low.

- The numeric risks for cancer from exposure to arsenic and benzo(a)pyrene, over a lifetime of exposure, are insignificant for adults and children.

- A completed exposure pathway from groundwater does not exist because groundwater sampling indicates that groundwater at the CSXT site has not been impacted by past releases of hazardous substances.

- Buildings and structures in the inaccessible areas form an impermeable cap over the hazardous substances found in the soil. Moreover, engineering controls such as sidewalks, landscape, etc. will be implemented to control access to the subsurface soils in this area. Hence, there is no exposure pathway from inaccessible areas.

Recommendations

- A copy of this health consultation will be provided to CSXT with the recommendation that workers be informed of potential exposures.

Public Health Action Plan

Actions Completed

- From October 2003 to January 2004, GDPH conducted an environmental health education needs assessment to formally collect and document community concerns. The results of the needs assessment are in the report, *Environmental Health Education Needs Assessment: CSXT DePriest Signal Shop, Savannah, Chatham County, Georgia*.
- In October 2003, the Chatham County Health Department offered free blood lead level screenings to local residents. On November 5 and November 22, approximately 200 individuals were tested for blood lead levels. All blood lead level test results were below 10 micrograms of lead per deciliter of whole blood (µg/d).
- Staff from GDPH and the Chatham County Health Department attended several public meetings in late 2003 and early 2004 to answer questions and address health related concerns.
- GEPD ensured that measures were in place to monitor and reduce residents' exposure to contaminated soil during remediation activities.
- Remediation activities were completed at EBES in August 2004 and at MP in October 2004. Post-remediation sampling verification will eliminate the potential for future exposure to contaminated soil in the EBES and MP.
- Buildings and structures in the inaccessible areas form an impermeable cap over the hazardous substances found in the soil. Moreover, engineering controls such as sidewalks, landscape, etc. will be implemented to control access to the subsurface soils in this area. Hence, there is no exposure pathway from inaccessible areas.

Actions Planned

- If additional data become available, the information will be reviewed by GDPH and appropriate actions will be taken.
- GDPH will continue to provide health education materials to community residents regarding the health effects from exposure to contaminants and effective methods of preventing and reducing exposure.
- GDPH will respond to all requests for health information regarding this site.

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Certification

This CSXT Depriest Signal Shop Health Public Health Consultation was prepared by the Georgia Department of Human Resources, Division of Public Health 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.

Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR

APPENDICES

APPENDIX A: Figures

Figure 1: Area and Demographic Map

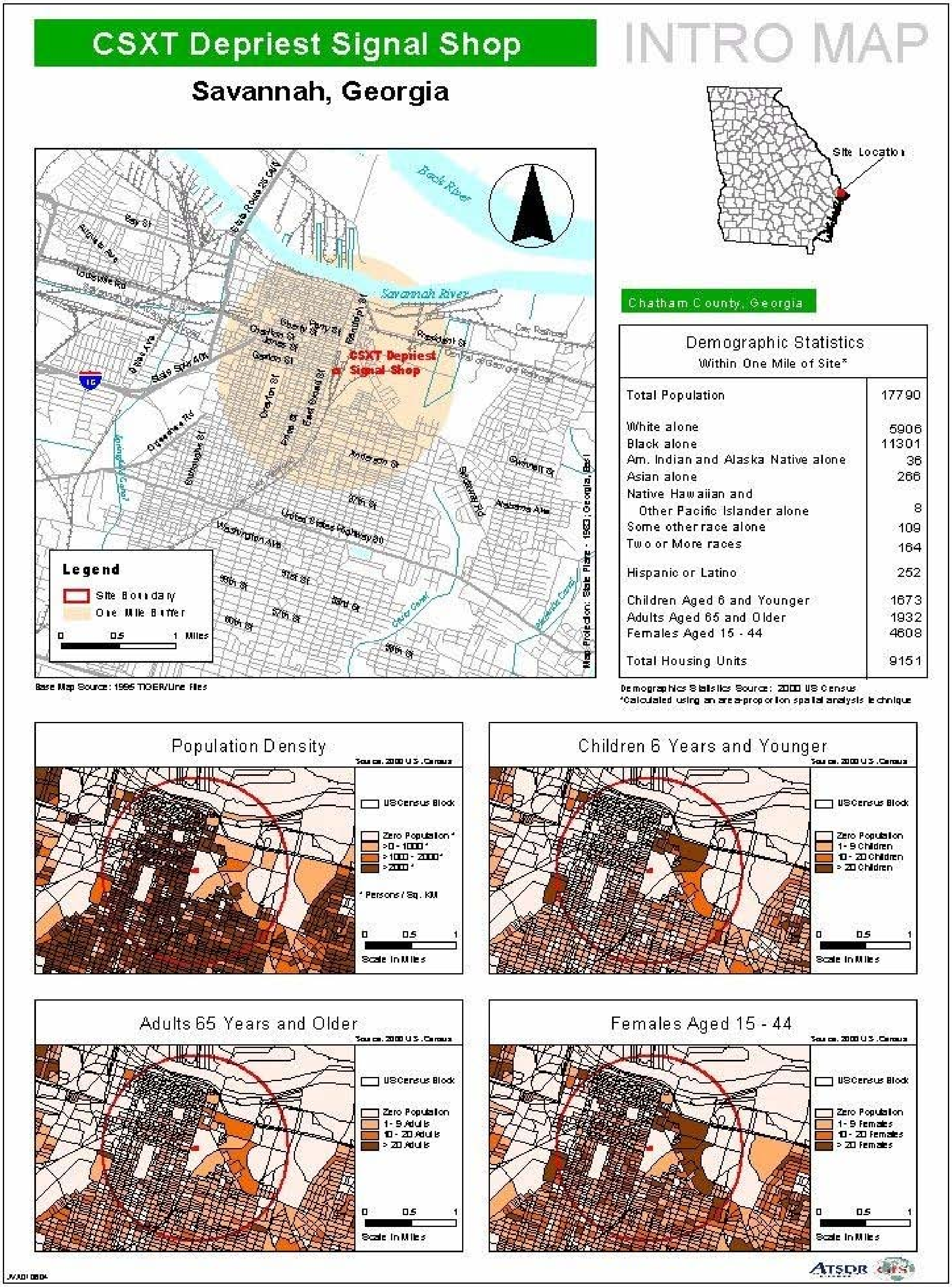


Figure 2: East Broad Elementary School

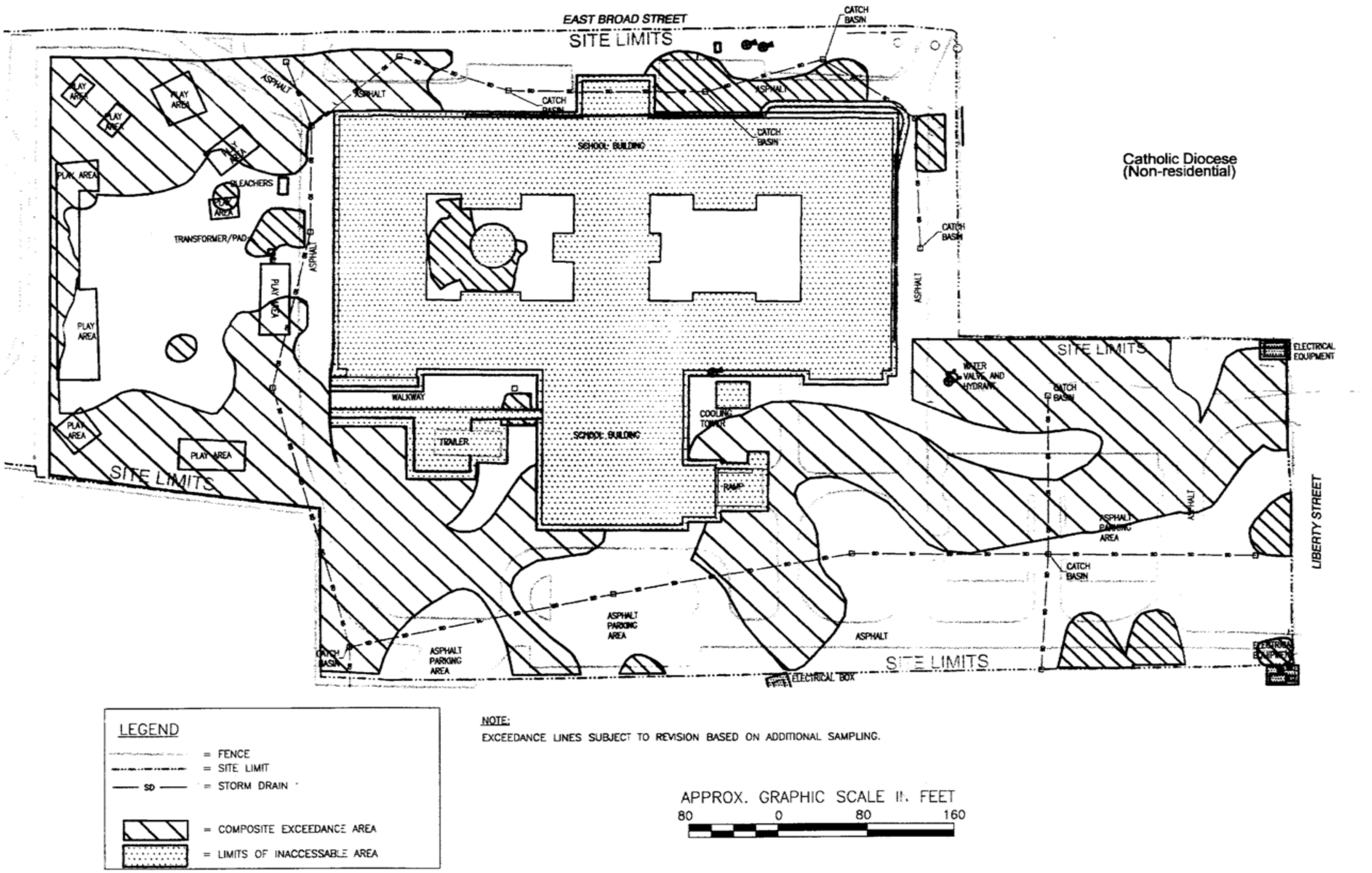
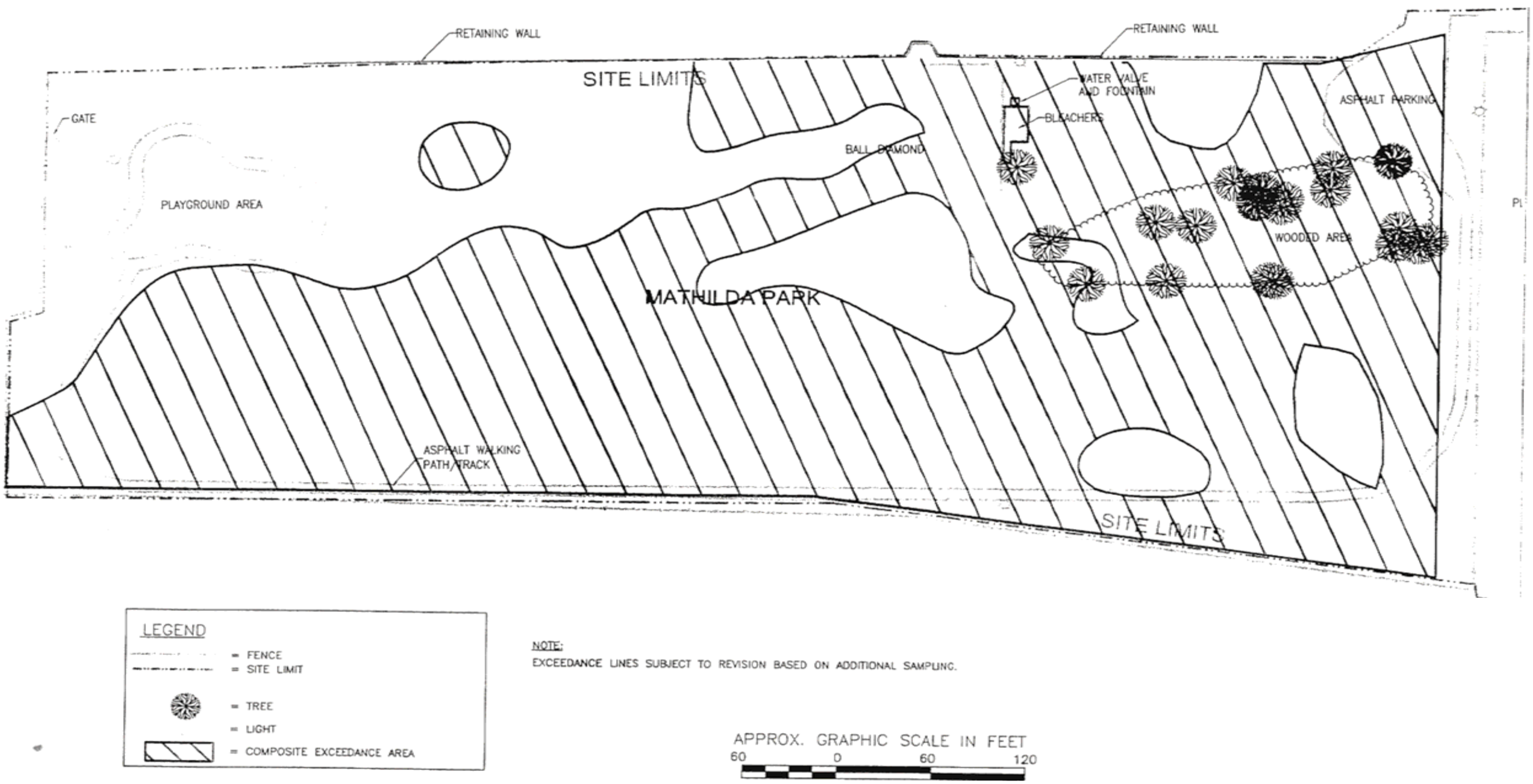


Figure 3: Matilda Park



APPENDIX B: Explanation of Evaluation Process

Step 1--The Screening Process

In order to evaluate the available data, GDPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the health consultation process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this health consultation are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that is based on EPA's estimate of daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is an estimated comparison concentration that is based on an excess cancer rate of one in a million persons exposed over a lifetime (70 years), and is calculated using EPA's cancer slope factor.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses used in this health consultation are presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in soil

Exposure doses for ingestion of contaminants present in soil were calculated using the average detected concentrations of contaminants in milligrams per kilogram (mg/kg [mg/kg = ppm]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated soil:

$$ED_s = \frac{C \times IR \times EF \times CF}{BW}$$

where;

ED_s = exposure dose soil (mg/kg/day)
C = contaminant concentration (mg/kg)

IR = intake rate of contaminated medium (based on default values of 100 mg/day for adults, 200 mg/day for children, and 5000 mg/day for a children with *pica*)

EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for EBES is 0.05, based on exposure for 4 hours/day, 5 days/week, for 6 years. The exposure factor used for MP is 0.06, based on exposure for 2 hours/day, 7 days/week, for 9 years

CF = kilograms of soil per milligram of soil (10^{-6} kg/mg)

BW = body weight (based on average rates: for adults, 70 kg; children, 25 kg; children with *pica*: 16 kg)

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation:

Minimal Risk Levels (MRLs) are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the theoretical excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX D: ATSDR LEAD MODEL*

Numerous longitudinal and cross-sectional studies have attempted to correlate environmental lead levels with blood lead levels. The studies have provided a number of regression analyses and corresponding slope factors for various media including air, soil, dust, water, and food. In an attempt to use this valuable body of data, ATSDR has developed an integrated exposure regression analysis. This approach utilizes slope values from selected studies to integrate all exposures from various pathways, thus providing a cumulative exposure estimate expressed as total blood lead. The worktable in the text can be used to calculate a cumulative exposure estimate on a site-specific basis. To use the table, environmental levels for outdoor air, indoor air, food, water, soil, and dust are needed. In the absence of such data, default values can be used. In most situations, default values will be background levels unless data are available to indicate otherwise. Based on the US Food and Drug Administration's Total Diet Study data, lead intake from food for infants and toddlers is about 5 micrograms per day. In some cases, a missing value can be estimated from a known value**.** For example, EPA has suggested that indoor air can be considered 0.03 times the level of outdoor air.

Empirically determined or default environmental levels are multiplied by the percentage of time one is exposed to a particular source and then multiplied by an appropriate regression slope factor. Slope factor studies were based upon an assumption that exposure is continuous. The slope factors can be derived from regression analysis studies that determine blood lead levels for a similar route of exposure. Typically, these studies identify standard errors describing the regression line of a particular source of lead exposure. These standard errors can be used to provide an upper and lower confidence limit contribution of each estimate of blood lead. The individual source contributions can then be summed to provide an overall range estimate of blood lead. While it is known that such summing of standard errors can lead to errors of population dynamics, detailed demographic analysis (e.g., Monte Carlo simulations) would likely lead to a model without much utility. As a screening tool, estimates provided by the table have a much greater utility than single value central tendency estimates, yet still provide a simple-to-use model that allows the health assessor an easy means to estimate source contributions to blood lead.

* U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, *Draft Toxicological Profile for Lead*. 1997.

Table D.1 Estimated blood lead levels from exposure to environmental and dietary lead for persons exposed to surface soil lead at the East Broad Street Elementary School.

Media	Concentration*	Relative Time Spent (fraction of a day)	Slope Factor**	Estimated Blood Lead Level micrograms per deciliter (µg/dL)	
Outdoor Air	0.15 µg/m^3	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 µg/m^3	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	4 µg/day	1	0.16 [4]	0.64	
Soil	1,185 mg/kg #	0.2	0.00583 (low)[5]	1.38	
			0.00777 (high)[5]		1.84
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.201	
			0.008 (high)[6]		0.256
				3.62	**4.315**

Table D.2 Estimated blood lead levels from exposure to environmental and dietary lead for persons exposed to surface soil lead at Matilda Park.

Media	**Concentration***	**Relative Time Spent (fraction of a day)**	**Slope Factor****	**Estimated Blood Lead Level micrograms per deciliter (µg/dL)**	
Outdoor Air	0.15 µg/m^3	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 µg/m^3	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	4 µg/day	1	0.16 [4]	0.64	
Soil	549 mg/kg #	0.2	0.00583 (low)[5]	0.64	
			0.00777 (high)[5]		0.853
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.201	
			0.008 (high)[6]		0.256
				2.88	**3.33**

When suggested default values are a range of values, the average of the range is used as the default value
Average surface soil concentration of lead found in all samples collected and analyzed above the EPA screening level of 400 ppm.
* Suggested default values references:

Outdoor Air	0.1–0.2 µg/m^3 [1]
Indoor Air	0.1–0.2 µg/m^3 [2]
Food	5 µg/day [3]
Water	4 µg/day [4]
Dust	10–70 mg/kg [5]

** Slope values references

[1,2]Outdoor, Indoor air	1.32 (low)–2.52 (high)	µg/dL per µg Pb/m^3 [6]
[3]Food	0.24	µg/dL per µg Pb/day [8]
[4]Water	0.16	µg/dL per µg Pb/day [8]
[5]Soil	0.00583 (low)–0.008 (high)	µg/dL per µg Pb/kg [6]
[6]Dust	0.00628 (low)–0.008 (high)	µg/dL per µg Pb/kg [6]

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APPENDIX E: ATSDR Public Health Hazard Conclusion Categories

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

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

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.

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

Urgent Public Health Hazard

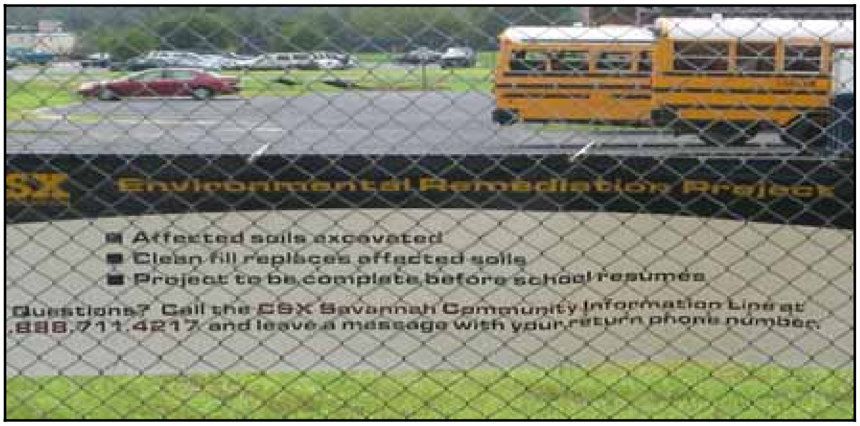
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Appendix F: Photographs

1. East Broad Street Elementary School (EBES) playground. Children may have been exposed to contaminants in surface soil.

2. EBES playground. Children may have been exposed to contaminants in soil underneath playground equipment.

3. Deactivated swing set at the south end of EBES. Fencing and berm at the north end of MP are to prevent runoff from remedial activities from reaching EBES.



4. Sign placed at EBES during remediation and site restoration activities.

5. Matilda Park (MP) before remediation began. Children and adults may have been exposed to contaminants in some areas with bare soil.

6. After remediation was complete, site restoration activities were conducted for the baseball field in MP. A groundwater monitoring well can be seen in the center of the photograph.

7. Northwest corner of MP. Part of EBES's roof can be seen. The lined fence helps prevent renegade dust and the berm prevents site runoff during cleanup and restoration activities.

FACT SHEET

Arsenic in Soil

This fact sheet provides general information about arsenic and its presence in soil, and how to reduce exposure to arsenic in soil.

What is arsenic (pronounced "*Are-sen-ick*")?

Arsenic is a naturally occurring, gray metal-like substance widely distributed in the earth's crust. Inorganic arsenic is usually found in the environment combined with oxygen, chlorine, and sulfur. In animals and plants, arsenic combines with carbon and hydrogen to form organic arsenic. Inorganic and organic arsenic compounds usually have no smell or taste.

Inorganic arsenic is mainly used as a preservative for wood to make it resistant to decay. Organic arsenic compounds are used to make pesticides, primarily for cotton plants.

How might I be exposed to arsenic?

- Breathing contaminated workplace air (wood treating, pesticide formulation, copper and lead smelting industries).
- Inhaling smoke or sawdust from wood treated with arsenic.
- Eating food, drinking water, or breathing air contaminated with arsenic.
- Living in an area with above-average levels of arsenic in rock.
- Living near a hazardous waste site that has releases of arsenic.

What happens to arsenic when it enters soil?

- When released into the air from industry emissions or as dust, arsenic settles back to the ground. Most of the arsenic in soil comes from particles falling out of the air.
- Arsenic in soil does not break down, but is changed from one form to another by chemical reactions and by bacteria that live in soil and water.
- Arsenic can dissolve in water and be transported to surface water and ground water, and attach to sediment on the bottom of a lake or river.

How can arsenic in soil affect my health?

Several studies have determined that exposure to inorganic arsenic is more harmful than to organic arsenic. A urine test is the most reliable test for arsenic exposure. To test for urine arsenic levels, one can consult a physician about testing procedures.

Exposure to arsenic in soil can occur by swallowing contaminated dirt, inhaling contaminated dust, and eating contaminated foods. Swallowing or breathing high levels of inorganic arsenic over a period of time can cause a sore throat, small corns or warts on the palms, soles and torso, damage to the kidneys, liver, and bladder, and irritated lungs. Depending on the level of arsenic exposure, and the length of time exposed, arsenic can lead to cancer.

Arsenic exposure during pregnancy can cause low birth weight or disrupt fetal development. High levels of exposure can cause death of the fetus. In children, arsenic poisoning has the same effects as in adults; however, children are at greater risk for exposure because of an increase in hand to mouth activity, and for eating contaminated soils. Also, because of a child's size and developing body systems, smaller doses can have greater affects on children.

How did the Georgia Division of Public Health get involved in investigating my neighborhood?

The Georgia Division of Public Health was asked by the Georgia Department of Natural Resources, Environmental Protection Division (GEPD) to review soil data collected from Matilda Park and the East Broad Elementary School playground near the CSXT DePriest Signal Shop in Savannah. Residents are concerned that the park and playground may have contaminated soil from past operations at the facility. In September 2003, the GEPD found arsenic in soil at potentially unsafe levels in three locations in Matilda Park. At this time, GEPD has overseen the remediation of Matilda Park and E. Broad Elementary School.

How can I reduce my exposure to arsenic in soil?

- There are several things you can do to reduce your contact with arsenic:
- Cover bare soil with grass, plants, gravel, or wood chips
- Test garden soil for arsenic and limit the food you eat that is grown in contaminated soil
- Do not let children play on bare soil; instead, have children play in grassy area or sandbox that can be covered
- Wash hands after playing or working outdoors
- Remove shoes before entering the house
- Use a doormat to reduce tracking dust and soil indoors
- Bathe pets who play outdoors regularly

For More Information, Contact:

GEORGIA DEPARTMENT OF HUMAN RESOURCES
Division of Public Health
Environmental Health and Injury Prevention Branch
Chemical Hazards Program
2 Peachtree Street, 13th Floor
Atlanta, Georgia 30303
(404) 657-6534
www.health.state.ga.us/programs/hazards

Other websites:
www.atsdr.cdc.gov
www.epa.gov/arsenic

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FACT SHEET

Lead in Soil

This fact sheet provides general information about lead and its presence in soil, and how to reduce exposure to lead in soil.

What is lead? (pronounced "*led*")

Lead is a naturally occurring, bluish-gray metal found in small amounts in the earth's crust. It has no special taste or smell. Lead can be found in all parts of our environment. Most of it came from human activities like mining, manufacturing, and burning fossil fuels.

Lead has many different uses, most important in the production of batteries. Lead is also used in ammunition, metal products, plumbing, roofing, and devices to shield x-rays. Because of health concerns, lead levels in the environment from gasoline, paints, ceramic products, and caulking have been dramatically reduced in recent years.

How might I be exposed to lead?

- Breathing workplace air (lead smelting, refining, and manufacturing industries).
- Eating lead-based paint chips or lead-contaminated soil.
- Drinking water that travels through lead-soldered pipes.
- Eating food grown in lead-contaminated soil, or eating food and drinking water contaminated with lead dust.
- Inhaling lead dust from hobbies that use lead (stained glass, ceramics).

What happens to lead when it enters soil?

- When released to the air from industry or burning fossil fuels or waste, lead stays in air about 10 days and then falls to the ground. Most of the lead in soil comes from particles falling out of the air.
- Lead in soil does not break down, but lead is changed by sunlight, air, and water into less toxic compounds.
- Lead sticks to soil particles and can be transported to surface water and ground water.

How can lead in soil affect my health?

Past studies have tried to link lead levels in soil with blood lead levels, but no conclusions have been made on how much increased blood lead levels can be expected from exposure to lead in soil. Key factors that help determine the amount of lead ingested are the exposure period and frequency, a person's age, and lead sources.

Lead exposure is more dangerous for young and unborn children than any other population. Unborn children can be exposed to lead from their mothers. Harmful effects include premature birth, low birth weight, learning difficulties, and reduced growth rate. These effects are more common after exposure to high levels of lead over a period of time.

The Centers for Disease Control and Prevention considers children to have been exposed to an elevated level of lead if the amount of lead in their blood is at least 10 micrograms per deciliter of blood. To test for blood lead levels, one can consult a physician or the local health department about testing procedures.

How did the Georgia Division of Public Health get involved in investigating my neighborhood?

The Georgia Division of Public Health was asked by the Georgia Environmental Protection Division (GEPD) to review soil data collected from Matilda Park and the E. Broad Elementary School Playground located near the CSXT DePriest Signal Shop in Savannah. Residents have expressed concern that soil at the park and school playground may have been contaminated. In September 2003, GEPD found lead in soil at levels of health concern in three areas of Matilda Park. At this time, GEPD has overseen the remediation of Matilda Park and E. Broad Elementary School.

How can I reduce my exposure to lead in soil?

- There are several things you can do to reduce your contact with lead:
- cover bare soil with grass, plants, gravel, or wood chips
- test garden soil for lead
- do not let children play near walls of house or garage, or on bare soil
- have children play in grassy area or sandbox that can be covered
- wash hands after playing or working outdoors
- remove shoes before entering the house
- use a doormat to reduce tracking dust and soil indoors

For More Information, Contact:

GEORGIA DEPARTMENT OF HUMAN RESOURCES
Division of Public Health
Environmental Health and Injury Prevention Branch
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www.epa.gov/lead

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