HEALTH CONSULTATION

EAST WASHINGTON FLUFF SITE

PHOENIX, ARIZONA

Prepared by:

Arizona Department of Health Services
Environmental Health Consultation Services

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Under cooperative agreement with the Agency for Toxic Substances and Disease Registry

Purpose

This health consultation is being conducted at the request of the City of Phoenix, Office of Environmental Programs. The purpose of the report is to evaluate environmental conditions and data at the East Washington Fluff Site, in Phoenix, AZ to determine whether a public health hazard exists as a result of exposure to contaminants in soils at the property. The City of Phoenix considers the site to be one of its highest priority brownfield projects due to its size, location, and threat to the public.

Background

The 10-acre site is located at the southwest corner of 5th Street and Buckeye Road and was used as a metals salvage yard and auto crushing facility from 1971-1986. The site has remained vacant since 1986 when the owner abandoned the property. Concrete, construction debris and remnants of former structures are present at the site. Most of the property is completely fenced with chain-link fencing with barbed wire at the top.

The ground surface of the site is uneven and disturbed. Nearly the entire site is covered with solid waste including metal debris, tires, empty drums, construction debris, refuse, ceramics, empty alcoholic beverage bottles and cans, and human waste. A large pile of automobile fragments known as auto "fluff" is present on the southeast corner of the property. Contamination of soils at the site has occurred by disposal of auto fluff and transformer oils. The contaminants at the site include various metals and polychlorinated biphenyls (PCBs)[1].

The Arizona Department of Environmental Quality (ADEQ) constructed a fence around the site in May 1997 in response to numerous reports of public exposure at the property, including homeless persons camping on the site, children walking across the property, and sporadic incidents of illegal dumping. The fence has been periodically breached by transients and repaired by the ADEQ, and there have been numerous reports of homeless persons camping at the site since construction of the fence. The ADEQ most recently re-fenced the property in May 2000. Three new holes in the fence were observed and repaired in early June 2000. The fenced area is posted with signs that warn that hazardous substances are present at the site.

Land uses in the vicinity of the site include manufacturing facilities, warehouses, storage yards, and distribution facilities for trucking operations. There are 2 houses directly east of the site. There is a residential neighborhood approximately 0.25 miles to the south of the property. Bank One Ballpark is located approximately 0.4 miles north of the site.

In March 2000, Ecology and the Environment, Inc. conducted a Targeted Site Assessment (TSA) of the property for the USEPA Region 9. The report found that fill mixed with solid waste encompasses nearly the entire site area to a depth of approximately 9 feet, with the range of depths from 0 to 18 feet [1]. The contractors reported that homeless persons were present at the property during the investigation.

The TSA included an analysis of a total of 230 soil samples from 72 grid locations for cadmium, chromium and lead using X-Ray Fluorescence (XRF) analysis. Based upon the XRF results, 24 of the samples were submitted to a laboratory and analyzed for these 3 metals and PCBs. Additionally, 3 samples were collected and analyzed by the laboratory for PCBs at the Main Fluff Pile and Pile # 1.

The average concentration of PCBs in the ground surface to waste-soil contact was 36.7 mg/kg. The average PCB concentration in the main fluff pile was 125 mg/kg. The average lead concentration in the main fluff pile was 5,440 mg/kg. Soil sample data are displayed in Table 1 and 2.

Table 1. Average site chemical concentrations in ground surface to waste-soil contact samples

Chemical	Number of samples	Average Concentration (mg/kg)	Nonresidential SRL (mg/kg)	Concentration exceeds Nonresidential SRL?
Total PCBs	12	36.7	13	**Yes**
Lead	82	1,581	2000	No
Cadmium	82	52.5	850	No
Chromium	82	157	4500	No

Table 2. Average chemical concentrations in main fluff pile surface samples

Chemical	Number of samples	Average Concentration (mg/kg)	Nonresidential SRL (mg/kg)	Concentration exceeds Nonresidential SRL?
Total PCBs	3	125	13	**Yes**
Lead	6	5,440	2,000	**Yes**
Cadmium	--	--	850	--
Chromium	6	119	4,500	No

Ecology and the Environment, Inc. analyzed samples for PCBs if XRF screening data for metals suggested that the sample was contaminated with metals present in auto shredder fluff. Samples that had low levels of metals were not analyzed for PCBs. The sampling protocol has a bias toward analyzing those samples which are known to be contaminated. This protocol likely has the effect of overestimating average on-site PCB concentrations.

Three monitoring wells have been installed on the property. There was no groundwater contamination above USEPA Maximum Contaminant Levels (MCLs) in any of the monitoring wells.

None of the wells had any detection of PCBs.

Discussion

PCBs

The soil and fill at the site contains average PCB at levels well above background levels and higher than the ADEQ residential and non-residential Soil Remediation Levels (SRLs). SRLs are screening-level Arizona soil cleanup standards promulgated in rule by the ADEQ [2].

PCBs are a group of synthetic organic chemicals that contain more than 200 chlorinated biphenyl compounds with varying harmful health effects. PCBs do not occur naturally in the environment. They are either oily liquids or solids. They have no taste or smell. PCBs enter the environment as mixtures containing a variety of individual components and impurities. Most of the information regarding the health effects from exposure to PCBs relate to the 7 types of PCB mixtures formerly sold in the United States. The manufacture of PCBs was stopped in 1977 because of its potential to cause health effects and their negative affect on the environment.

PCBs can be released into the environment at poorly maintained hazardous waste sites and from spills and leaks from transformers, capacitors and other products. PCBs are common contaminants at former automobile shredding plants.

PCBs bind strongly to soil and often remain stable for years. They do not travel deep into soils, and they rarely migrate to groundwater. Exposures that occur off-site are primarily from inhaling fugitive (blowing) dust that may have PCB particles attached to the small soil particles. This report evaluates the potential for off-site exposure to PCBs from blowing dust. The tables in the Appendix display the equations and assumptions used to quantify exposures.

People that go on-site can also be exposed to PCBs by direct contact with contaminated soils when the site fence is breached and persons enter the fenced property. When direct exposure to contaminants occurs, PCBs can get into peoples bodies by ingestion, inhalation and dermal (skin) contact. Some of the PCBs that enter the body are metabolized and excreted from the body within a few days, however, others stay in the body fat and liver for months and even years.

Skin irritation, such as acne and rashes can occur in people exposed to PCBs. Other health effects that have occurred from chronic exposure to PCBs in the workplace include irritation of the nose and lungs, weakness, numbness, respiratory problems, altered immune response, and liver damage. It is unknown whether PCBs cause cancer in humans, however, the available data suggests that PCBs can reasonably be anticipated to be carcinogens.

The ATSDR has developed a chronic exposure Minimal Risk Level (MRL) for PCBs of 0.00002 mg/kg per day. The chronic MRL was based upon a number of laboratory animal studies, including a study that demonstrated skin problems in adult monkeys at doses of as low as 0.005 mg/kg per day.[3] MRLs are daily exposure estimates that are likely to be without a risk of adverse health effects. MRLs contain a safety factor to protect sensitive sub-populations including children

The ATSDR has not developed acute or intermediate MRLs for PCBs. The chronic MRL 0.00002 mg/kg per day is used to evaluate chronic and intermediate exposure to PCBs at the site. The lowest observed adverse effect level of 0.005 mg/kg per day is used to evaluate acute or short term exposure.

While there do not appear to be any longtime resident homeless individuals at the site, there are incidents with documented human activity within the fence at the site. The duration and frequency of the exposures are unknown. In the absence of these data we made conservative assumptions regarding exposures that may be occurring at the site. Table 3 displays estimated daily PCB doses from off-site exposure and direct contact with soils at the site.

The equations and assumptions used to calculate exposure doses from on-site and off-site exposures are displayed in Equation A-1 in the Appendix. Off-site exposures are modeled using an air modeling equation developed by the USEPA to conservatively estimate off-site exposures from fugitive dust emissions.

On-site exposure doses include uptake of PCB by ingestion and dermal contact with contaminated soils, and inhalation of contaminated blowing dust from the site. Off-site exposures only include uptake from inhaling contaminated blowing dust from the site.

Table 3. Comparison of PCB exposure doses to MRLs

Exposure	Child dose (mg/kg-day)	Adult dose (mg/kg-day)	Chronic MRL (mg/kg-day)	Child dose exceeds Chronic MRL?	Adult dose exceeds Chronic MRL?
Direct contact with on-site surface soils	0.0006	0.0001	0.00002	**Yes**	**Yes**
Direct contact with the main fluff pile	0.002	0.0003	0.00002	**Yes**	**Yes**
Off-site exposure to fugitive dust from site	0.000000005	0.000000003	0.00002	No	No

Estimated exposures from direct contact with the contamination are greater than the chronic MRL for PCBs for both children and adults for all on-site exposure areas. Estimated child exposure doses from direct contact with the main fluff pile are approximately half of the lowest observed adverse effect level of 0.005 mg/kg per day in the scientific literature.

These results suggest that a public health hazard may exist when the fence is breached and direct contact with contaminated soil occurs at the site. The primary health effects that could occur include skin irritation and rashes, particularly if exposures to the main fluff pile occur.

Estimated off-site exposures as a result of inhalation of fugitive dust emissions from surface soils at the site were well below the chronic MRL, suggesting that off-site exposure to PCBs in fugitive dust present no apparent public health hazard.

Lead

Average lead levels in surface soils at the site do not exceed the nonresidential or residential SRL for lead. However, lead levels in the main fluff pile are significantly elevated above background levels and exceed the nonresidential SRL of 2,000 mg/kg.

Overall, average lead levels at the site are below screening levels. However, lead levels in the main fluff pile are in excess of 5,000 mg/kg, and repeated child access to the main fluff pile could result in significant lead exposures to children. While the levels of lead at the site as a whole do not represent a public health hazard, the main fluff pile represents a public health hazard when direct access by children to the site is not prevented.

ATSDR's Child Health Initiative

ATSDR's child health initiative recognizes the unique vulnerabilities of children exposed to environmental chemicals. Children cannot simply be characterized as small adults, and they have greater opportunities for exposure, increased potential for health problems and less ability to avoid hazards than adults.

Children are more likely to be sensitive to the effects of chemicals due to their developing physiology and their low body weight. Pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults. With consideration to this fact, conservative variables were used in dose calculations to account for their greater susceptibility.

PCBs in particular are known to pose a higher risk for children at lower levels due to their immature physiology which makes them less able to metabolize and excrete toxic chemicals, which is the body's natural defense in detoxifying most contaminants. Recent studies have shown that in diseases with previously unknown etiologies, chemicals in the environment may also act as a "trigger" mechanism for the development of a disease over a child's longer life span. Moreover, children tend to have increased hand to mouth behavior and they play closer to the ground, and thus have the potential to ingest more soil than older children and adults.

The results of our evaluation of the environmental data from the East Washington Fluff Site suggest that a public health hazard may exist to children when the fence is breached and direct contact with soils at the site occurs. PCB and lead exposure doses from direct contact with the main fluff pile present an acute public health hazard to children. The primary health effects that could occur from exposure to PCBs include skin irritation and rashes.

Conclusions

The results of our evaluation of the environmental data from the East Washington Fluff Site suggest that **a public health hazard** may exist when the fence is breached and direct contact with soils at

the site occurs. PCB and lead exposure doses from direct contact with the main fluff pile present an **acute public health hazard** to children. The primary health effects that could occur from exposure to PCBs include skin irritation and rashes.

Off-site exposure to contaminants from blowing dust originating at the site are well below screening levels and present **no apparent public health hazard**.

The sampling protocol used by the environmental investigation team had a sampling protocol that has a bias toward analyzing samples for PCBs which are known to be contaminated. This likely has the effect of overestimating average on-site PCB concentrations and health risks. However, the on-site concentrations found suggest that a number of hotspots exist at the site which represent a health hazard from on-site exposure.

Recommendation

Permanent measures should be taken to prevent direct exposure to the contaminated surface soils at the site.

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References

1. Ecology and Environment, Inc. 2000. East Washington Fluff Site, Brownfields Targeted Site Assessment Report. Prepared for the United States Environmental Protection Agency. San Francisco, CA. March 2000.

2. Arizona Department of Environmental Quality. 1997. Soil Remediation Standards Rule. Arizona Administrative Code Title 18, Chapter 7, Article 2. December 4, 1997.

3. Agency for Toxic substances and Disease Registry.1997. Toxicological Profile for Polychlorinated Biphenyls. Atlanta, GA. September 1997.

Chronic Daily Intake Formulas

- ***Equation 1: Inhalation of {Fugitive} [fugitive] dust emissions***

  CDI= [(Conc $_{surface\ soil}$)(PEF)(IR)(EF)(ED)] / [(BW)(AT)]

  CDI: chronic daily intake (mg/kg/day)

  PEF : particulate emission factor (kg/m^3)

  IR: intake rate (m^3/day)

  EF : exposure frequency (days/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (days)

- ***Equation 2: Ingestion of chemicals in soil***

  CDI= [(CF)(IR)(EF)(ED)] / [(BW)(AT)]

  CDI: chronic daily intake (mg/kg/day)

  CF: conversion factor (10^{-6} kg/mg)

  IR: intake rate (mg/day)

  EF: exposure frequency (days/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (days)

- ***Equation 3: Dermal contact with soil***

  CDI= [($conc_{soil}$)(CF)(SA)(SAF)(AF)(EF)(ED)] / [(BW)(AT)]

  CDI: chronic daily intake (mg/kg/day)

  CF: conversion factor (10^{-6} kg/mg)

  SA: Skin surface area (cm^2/event)

  SAF: Skin adherence factor

  AF: absorption factor

  EF: exposure frequency (event/yr)

  ED: exposure duration (yrs)

  BW: body weight (kg)

  AT : Averaging time (event)

Standard Default Exposure Factors]

Symbol	Definition (units)		Default	Reference
CSFo	Cancer slope factor oral (mg/kg-d)		-	IRIS, HEAST†
CSFi	Cancer slope factor inhaled (mg/kg-d)		-	IRIS, HEAST
RfDo	Reference dose oral (mg/kg-d)		-	IRIS, HEAST
RfDi	Reference dose inhaled (mg/kg-d)		--	IRIS, HEAST
BWa	Body weight, adult (kg)		70	RAGS‡ (Part A) EPA 1989 (EPA/540/1-89/002)
BWc	Body weight, child (kg)		15	Exposure Factors EPA 1991 (OSWER No. 9285.6-03)
]ATc	Averaging time - carcinogens (days)		25550	RAGS(Part A), USEPA 1989 (EPA/540/1-89/002)
ATn	Averaging time - noncarcinogens (days)		ED*365	
SAa	25% Surface area, adult (cm^2/day)		5000	Dermal Assessment EPA 1992(EPA/600/8-91/011B)
SAc	25% Surface area, child (cm^2/day)		2000	Dermal Assessment EPA 1992 (EPA/ 600/8-9/011B)
AF	Adherence factor (mg/cm^2)		0.2	Dermal Assessment EPA 1992 (EPA/600/8-9/011B)
ABS	Skin absorption (no unit):			
	--Inorganics		0.01	PEA Cal-EPA (DTSC, 1994), ADHS SRLs
	–Organics		0.1	PEACal-EPA (DTSC, 1994), ADHS SRLs
IRAa	Inhalation rate - adult (m^3/day)		20	Exposure Factors EPA 1991 (OSWER No. 9285.6-03)
IRAc	Inhalation rate - child (m^3/day)	10	RAGS (Part A)0	EPA 1989 (EPA/540/1-89/002)
IRSa	Soil ingestion - adult (mg/day)	100	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
IRSc	Soil ingestion - child (mg/day),	200	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
EFr	Exposure frequency - residential (d/y)	350	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
EDr	Exposure duration - residential (years) 30[c]		Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
	Exposure duration - child (years)	6	Exposure Factors	EPA 1991 (OSWER No. 9285.6-03)
	Age-adjusted factors for carcinogens:			

IFSadj	Ingestion factor, soils [mg ! yr]/[kg ! d])	114	RAGS Part B)	EPA 1991 (OSWER No. 9285.7-01B)
IFSADJ	Skin contact factor, soils ([mg ! yr]/[kg ! d])	503		By analogy to RAGS (Part B)
InhFadj	Inhalation factor ([m^3 ! yr]/[kg ! d])	11		By analogy to RAGS (Part B)
PEF	Particulate emission factor (m^3/kg)	1.396 x 10^{+9}	Soil Screening Guidance	EPA 1996a

{SRLs = }
*IRIS =
†Heast =
‡RAGS =
SRLs = Residential Soil Remediation Levels as described in the Arizona Administrative Code, Title 18, Chapter 7, Article 2, Appendix A.

Table A-1 PCB Intake Exposures East Washington Fluff Site Main Fluff Pile

	Average Concentration mg/kg	Adult Exposure dose mg/kg-day	Child Exposure dose mg/kg-day
		Ingestion	Ingestion
PCBs	125.00	1.8e-04	1.7e-03
		Inhalation	Inhalation
		7.7e-09	1.8e-08
		Dermal	Dermal
		1.5e-04	3.4e-04
		Totals	Totals
		3e-04	**2e-03**

Table A-2 PCB Intake Exposures East Washington Fluff Site - Pile # 1

	Average Concentration mg/kg	Adult Exposure dose mg/kg-day	Child Exposure dose mg/kg-day
		Ingestion	Ingestion
PCBs	34.60	4.9e-05	4.6e-04
		Inhalation	Inhalation
		2.1e-09	5.0e-09
		Dermal	Dermal
		4.1e-05	9.5e-05
		Totals	Totals
		9e-05	**6e-04**

Table A-3 PCB Intake Exposures East Washington Fluff Site - Ground Surface to Waste Soil Contact Samples

	Average Concentration mg/kg	Adult Exposure dose mg/kg-day	Child Exposure dose mg/kg-day
		Ingestion	Ingestion
PCBs	36.70	5.2e-05	4.9e-04
		Inhalation	Inhalation
		2.3e-09	5.3e-09
		Dermal	Dermal
		4.3e-05	1.0e-04
		Totals	Totals
		1e-04	**6e-04**

Table A-4 Cadmium Intake Exposures East Washington Fluff Site- Ground Surface to Waste Soil Contact Samples

	Average Concentration mg/kg	Adult Exposure dose mg/kg-day	Child Exposure dose mg/kg-day
		Ingestion	Ingestion
Cadmium	52.50	7.5e-05	7.0e-04
		Inhalation	Inhalation
		3.2e-09	7.6e-09
		Dermal	Dermal
		6.2e-05	1.4e-04
		Totals	Totals
		1e-04	**8e-04**