Health Consultation

Public Health Evaluation of Soil Data

NEWHALL STREET SCHOOL

HAMDEN, CONNECTICUT

APRIL 18, 2001

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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HEALTH CONSULTATION

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Prepared by:

Connecticut Department of Public Health
under cooperative agreement with the
Agency for Toxic Substances and Disease Registry

The conclusions and recommendations in this health consultation are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will review additional information when received. The review of additional data could change the conclusions and recommendations listed in this document.

BACKGROUND AND STATEMENT OF ISSUE

The Connecticut Department of Public Health (CT DPH) was asked by the Quinnipiak Valley Health District, the Town of Hamden and the CT Department of Environmental Protection (CT DEP) to evaluate the public health significance of environmental contamination in soil around the Newhall Street School, located at 490 Newhall Street in Hamden, Connecticut. The Newhall Street School is located at the corner of Newhall and Morse Streets and is immediately adjacent to the Hamden Middle School. The Hamden Middle School is the focus of a larger environmental investigation which includes the interior of the school building, the property grounds and the athletic field behind the school. Those investigations have expanded beyond the Middle School property to Rochford Park located across Newhall Street, the surrounding residential area, and the Newhall Street School, which is the subject of this health consultation. Additional health consultations will be prepared for the other areas being investigated.

The Newhall Street School houses community programs for children and adults. There is a daycare with a total licensed capacity of 60 children, ages 3-12 years. There is also a drop-in youth center for children in grades 7 through 12 (ages 11 through 18) and a boxing program for ages 12 through adult. Numbers of participants in the drop-in and boxing programs vary from day to day. Numbers of participants in the two programs vary from a low of approximately 4 to a high of approximately 30 participants.

Environmental Data

In response to soil contamination discovered at the Hamden Middle School in November 2000, 14 surface soil samples (top 6 inches) were collected around the Newhall Street School. Samples were collected on December 16, 2000 and December 29, 2000 by contractors supervised by CT DEP and by CT DPH. Samples were tested for a large suite of semi-volatile compounds and metals. Table 1 summarizes the soil data and Attachment A is a map of soil sample locations. Soil results indicate the presence of elevated arsenic in 2 of the 14 samples (SS-6 and 68). The maximum detected concentration of arsenic was 31.3 ppm. However, a duplicate analysis of this sample showed 20.7 ppm. In 6 of the 14 samples, there were elevated levels of four polycyclic aromatic hydrocarbons (PAHs); benzo(a)anthracene, benzo(b)fluoranthene, indeno(123-cd)pyrene and benzo(a)pyrene. The maximum concentrations of benzo(a)anthracene, benzo(b)fluoranthene, indeno(123-cd)pyrene and benzo(a)pyrene are 4.2 ppm, 5.4 ppm, 2.9 and 2.2 ppm, respectively. Elevated PAHs were found at sample locations SS-1, SS-2, SS-3, SS-4, SS-5 and 64.

TABLE 1. Surface soil sample results from Newhall Street School, Hamden, CT

Contaminant	Maximum Concentration; ppm	CT RSR[@]; ppm	Number of samples exceeding CT RSR
Arsenic	31.3*	10	2 of 14
Benzo(a)anthracene	4.2	1	5 of 14
Benzo(b)fluoranthene	5.4	1	6 of 14
Indeno(123-cd)pyrene	2.9	1	5 of 14
Benzo(a)pyrene	2.2	1	1 of 14

[@] CT Remediation Standard Regulations; direct contact residential soil cleanup standards. Based on 365 d/y exposure for 30 years.
* A duplicate analysis of this result showed 20.7 ppm.

DISCUSSION

Evaluation of public health implications to adults and children

When determining the public health implications of exposure to hazardous contaminants, CT DPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective comparison values. When contaminant levels are below comparison values, we can say with relative certainty that health impacts from exposure to those levels are unlikely. When contaminant levels exceed comparison values, it does not mean that health impacts are likely. Rather, it means that exposures should be evaluated further. CT DPH has determined that the most appropriate comparison values to use for the chemicals detected at the Newhall Street School are the Connecticut Remediation Standard Regulations direct contact residential soil standards (CT RSRs). There are comparison values developed by ATSDR for arsenic and benzo(a)pyrene but they are below commonly achieved detection limits so they are of limited use in evaluating health implications at this site. CT DPH notes that using the CT RSRs does not result in arsenic and benzo(a)pyrene being eliminated from further evaluation.

In order to be exposed to contaminants in soil, you must come into direct contact with the soil by touching the soil, inhaling soil particles or eating soil adhered to fingers or food items. At the Newhall Street School, possible pathways of exposure are skin contact with soil and ingestion of soil. Inhalation of soil particles is not considered to be an important pathway because soil is vegetated and there is a very low potential for excessively dry and dusty soil conditions.

On the grounds of the Newhall Street School, there is no playground or other recreation area to attract children to frequently come into direct contact with soil. There are various paths and walkways around the property. The most heavily used area for walking is the "half courtyard" portion of the building. Paths and walkways lead from entrances in this portion of the building to the parking lot behind the building and to the Middle School. Walking across the soil appears to be the only activity that could result contact with soil.

As Table 1 indicates, arsenic and PAHs are the contaminants of interest at the Newhall Street school and will be evaluated further as described in the following paragraphs.

Arsenic

Arsenic is an element that is found naturally in soil at low levels. The arsenic that occurs naturally in soil is inorganic arsenic. Inorganic arsenic has been recognized as a human poison since ancient times. Eating very large doses of inorganic arsenic can produce death. At lower levels of exposure, over the long term, arsenic can produce a characteristic pattern of skin changes including darkening of the skin and lung and throat irritations. Arsenic is recognized as a known human carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver and lung. Attachment C provides a fact sheet with supplementary information about the health impacts from arsenic exposure.

It is important to emphasize that arsenic is found naturally in soils. Background arsenic concentrations in soil range from about 1 to 40 ppm (ATSDR 2000). Arsenic in soils may also originate from past use of pesticides containing arsenic. The history of the Newhall Street School site indicates that part, if not all of the building was built prior to construction of the Hamden Middle School and prior to wastes being placed at the Middle School site. In addition, the Newhall Street School is at a higher elevation than the Middle School. This historical information strongly suggests that landfilled waste was not deposited at the Newhall Street School site. Results from the 14 samples collected around the Newhall School support the historical information. Arsenic was found in a limited area at the Newhall Street School but is not a contaminant that is associated with waste found at the Middle School.

Arsenic was detected in two locations at levels approximately 3 times higher than the CT RSRs of 10 ppm for arsenic in residential soils (see Table 1). However, it is important to note that the residential RSRs were developed to be protective of young children playing frequently (7 days per week) and intensely in soil for many years in a setting such as a backyard or playground. CT DPH believes that such frequent and intense contact with the soil in the area where arsenic was found at the Newhall Street School is extremely unlikely. The area of elevated arsenic is on the southeast side of the building (closest to the corner of Newhall and Morse Streets). People do not walk through this area frequently because the building entrance on this side of the building is rarely, if ever used (personal communication, Susan Rabino, January 17, 2001). Moreover, if children or adults did walk through the area, little or any direct contact with the soil would occur, unless the person sat and played in the soil or dug into the soil with their hands.

Even though contact with the soil is unlikely, CT DPH did a risk calculation to assess the theoretical cancer and noncancer risks associated with a child's exposure to the maximum concentration of arsenic detected (31.3 ppm), assuming that the child was exposed to the soil 5 days per week for 18 years. CT DPH stresses that this exposure scenario is extremely unlikely. Nevertheless, if such frequent, direct contact with soil did occur, exposure to arsenic at the Newhall Street School represents a very low increased cancer risk. Regarding noncancer risks, exposures are well below the level of concern. Attachment B shows the detailed risk calculations.

Polycyclic Aromatic Hydrocarbons (PAHs)
PAHs are a group of over 100 different chemicals that are formed when coal, oil, garbage, tobacco, food or any other organic substances are burned. Some PAHs have caused cancer in laboratory animals when they were exposed for long periods of time. Some people who breathed or touched mixtures of PAHs and other chemicals for long periods of time developed cancer. Regarding noncancer effects from exposure to PAHs, animal studies have shown that PAHs can cause harmful effects on the skin, body fluids and immune system but these effects have not been seen in people. Attachment C provides a fact sheet with supplementary information about the health impacts from exposure to PAHs.

PAHs are present in soil almost everywhere. PAH levels found at the Newhall Street School are within the range of background reported for rural soils and are well below the range of background for urban soils (ATSDR 1995). Automobile and diesel emissions, tire wear and . asphalt are major sources of PAHs in soil, especially near roadways. PAHs are produced when any organic materials are burned. Residential wood burning, power plants and incinerators are sources of PAHs in air. PAHs stuck to particles in air can eventually settle out onto the soil.

Elevated levels of some PAHs (benzo[a]anthracene, benzo[a]pyrene, indeno[123-cd]pyrene and benzo[b]fluoranthene) were detected in a small number of locations around the Newhall Street School. Some of the soil samples had exceedances of the CT RSRs (see Table 1). As stated above, RSRs are developed to be protective of young children exposed to soil on a regular and continuing basis. It should be noted that PAH levels found at the Newhall Street school are significantly lower than the levels of PAHs found at the Middle School.

In evaluating the potential for exposure to PAHs at the Newhall Street School, CT DPH focused on PAH concentrations found in the 'half-courtyard' area of the school grounds that is the most heavily used for walking. This area encompasses soil samples SS-1, SS-2, SS-3, 64 and 57. CT DPH calculated the average PAH concentration for that area. A table showing the average and how it was calculate is included in Attachment B as Table B-1. The average concentration for all PAHs in the half-courtyard area is 1.77 ppm. This exceeds CT RSRs for PAHs by less than two times. Even though the average concentration of PAHs slightly exceeds CT RSRs, CT DPH believes that PAHs present in the soil do not approach levels which might cause adverse health impacts, given the type of activities that occur here (walking).

Even though PAH levels in soil are extremely unlikely to cause adverse health impacts, CT DPH did risk calculations to assess the theoretical cancer and noncancer risks associated with a child's exposure to average concentrations of PAHs detected in the "half courtyard" area. Exposure assumptions used in the risk calculations are the same as those used in the calculation for arsenic. The exposure scenario evaluated is extremely unlikely. Nevertheless, if such frequent, direct contact with soil did occur, exposure to PAHs at the Newhall Street School represents an insignificant increased cancer and noncancer risk. Attachment B shows the detailed risk calculations.

EVALUATION OF COMMUNITY HEALTH CONCERNS

Parents and staff of the daycare program have asked whether hazardous waste found in soil at the Hamden Middle School is also present at the Newhall Street School. They also questioned whether there is any danger to children and staff and whether the daycare program should be moved to another site. On December 27, 2000, the Quinnipiak Valley Health District sent a letter to the daycare stating that based on available information, waste materials do not appear to be present at the Newhall Street Building and there is no reason to move the program. The letter also said that additional data would be collected to supplement what was already known. Additional data were collected, and are evaluated in this health consultation. Based on an evaluation of all available data, there is no danger to children and staff and no reason for the daycare to move to another location.

CONCLUSIONS

Soil samples taken around the Newhall Street School building show the presence of some PAHs and arsenic. At a few sample locations, concentrations exceed very conservative health-based comparison values that were developed to be protective of frequent, long-term contact with soil by young children.

There is very little opportunity for direct contact with contaminated soil. Walking across the soil is not likely to result in much, if any exposure to soil. CT DPH did calculations of the theoretical risks from exposure to arsenic and PAHs, making very conservative assumptions about exposure. **These exposure assumptions far exceed exposures actually expected to occur at the site.** The calculations indicate that theoretical risks are not high enough to pose a concern.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories. ATSDR conclusion categories are included as Attachment D to this report. CT DPH has concluded that soils around the Newhall Street School building present no apparent public health hazard.

RECOMMENDATIONS

1. As an additional measure of protection, areas that are heavily used for walking should have well-maintained grass cover or be covered with gravel or wood chips. CT DPH notes that this is not a measure it considers necessary in order for the area to be considered safe. Rather, it is an action that can easily be taken and provides an added level of protection.

PUBLIC HEALTH ACTION PLAN

Actions Taken

1. The local health department sent a letter to the daycare responding to their questions and concerns regarding whether the daycare program should move to another location.

2. CT DPH has participated in all of the public meetings held to date regarding contamination at the Hamden Middle School and surrounding sites, including the Newhall Street School.

Actions Planned

1. CT DPH will make this health consultation available to parents and staff at the Newhall Street School.

2. CT DPH will continue to participate in public meetings regarding contamination at the Hamden Middle School and surrounding sites, including the Newhall Street School.

3. CT DPH will work with CT DEP and the local health department to respond to health questions and concerns regarding hazardous contaminants at the Newhall Street School.

REFERENCES

ATSDR 2000, Toxicological Profile for Arsenic, US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 2000.

ATSDR 1995, Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs), US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, August 1995.

ATSDR 1993. Public Health Assessment Guidance Manual, Agency for Toxic Substances and Disease Registry, 1993.

EPA 1999 **draft** Superfund Dermal Risk Guidance, December 1999

EPA 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa, August 1997.

IRIS. EPA Integrated Risk Information System, www.epa.gov/iris/subst/index.html.

CERTIFICATION

The Health Consultation for Soil Data at the Newhall Street School in Hamden Connecticut was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Technical Project Officer, SPS,SSAB,DHAC

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

Chief, SSAB,DHAC,ATSDR

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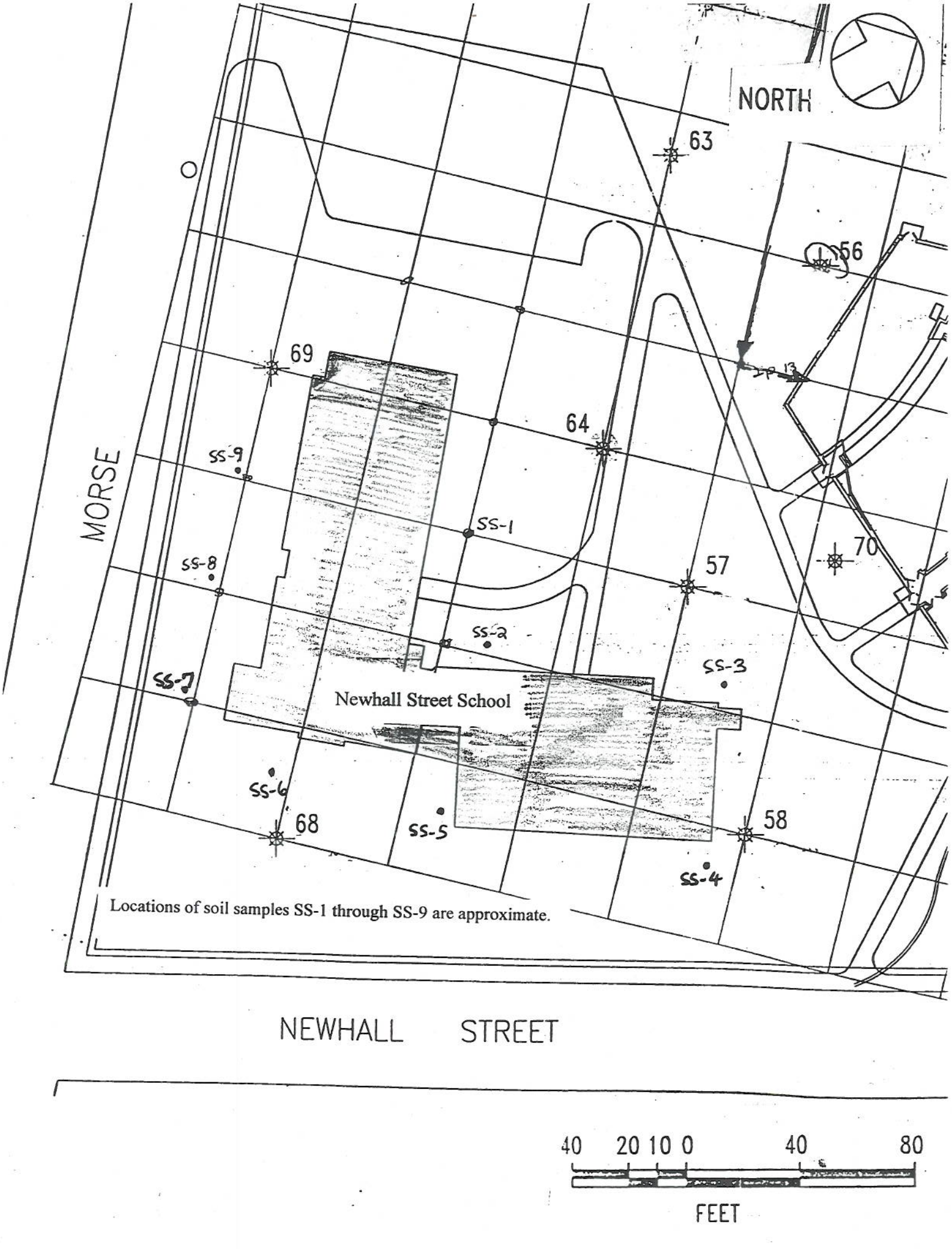
ATTACHMENT A

Map of Sampling Locations at the Newhall Street School, Hamden, CT


NORTH
63
56
69
64
MORSE
SS-9
SS-1
70
SS-8
57
SS-2
SS-3
SS-7
Newhall Street School
SS-6
68
SS-5
58
SS-4
Locations of soil samples SS-1 through SS-9 are approximate.
NEWHALL STREET
40 20 10 0 40 80
FEET

ATTACHMENT B

ATTACHMENT B Theoretical Risk Calculations

The exposure assumptions made in these risk calculations are extremely conservative. Actual exposures are almost certain to be much lower. These risk calculations were done to assess the magnitude of theoretical risks, given very conservative exposure assumptions. If theoretical risks using a very conservative exposure scenario are not of concern, then risks associated with actual exposures will not be of concern either.

A. Noncancer risks, child aged 1-6 years

1a. Ingestion Dose-Arsenic

$ADD_i = IR_c * [Soil] * EF * ED * C1 * C2 * 1/BW_c * 1/AT_{nc}$

ADD_i = 100mg/d * 31.3 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 1.3 E-4 mg/kg/day

1b. Ingestion Dose-PAHs

ADD_i = 100mg/d * 1.77 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 7.58 E-6 mg/kg/day

2a. Dermal Dose-Arsenic

$ADD_d = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * 1/BW * 1/AT_{nc}$

ADD_d = 31.3 mg/kg * 0.06 mg/cm2/-ev * 0.03 * 358 cm2 * 250 d/y * 6 y * 1 ev/d * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 8.6E-7 mg/kg/day

2b. Dermal Dose-PAHs

ADD_d = 1.77 mg/kg * 0.06 mg/cm2/-ev * 0.13 * 358 cm2 * 250 d/y * 6 y * 1 ev/d * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 2.1 E-7mg/kg/day

3a. Noncancer Hazard Index - Arsenic

$HI = ADD_i + ADD_d/RfD$

HI= (1.3E-4 mg/kg/day + 8.6E-7 mg/kg/day) / 3E-4 mg/kg/day

HI = 0.4

3b. Noncancer Hazard Index - PAHs

HI= (7.58E-6 mg/kg/day + 2.1 E-7 mg/kg/day) /0.02 mg/kg/day

HI = 0.0004

A Hazard Index of 1 means that the estimated dose is equal to the safe dose. A Hazard Index less than 1 indicates that the estimated dose is below the safe dose and noncancer health impacts are unlikely. A Hazard Index greater than 1 indicates that the estimated dose is above the safe dose and noncancer health impacts cannot be ruled out. In this case, Hazard Indices for both arsenic and PAHs are well below 1. This indicates that noncancer health impacts from arsenic and PAH exposure are unlikely.

B. Cancer Risks, child/adult age 1-18

1a. Ingestion Dose- Arsenic

$LADD_c$ = IR_c * [Soil] * EF * ED * C1 * C2 * 1/BW * $1/AT_c$

$LADD_c$ = 100 mg/d * 31.3 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/70 yr
= 1.1 E-5 mg/kg/day

$LADD_a$ = IR_a * [Soil] * EF * ED * C1 * C2 * 1/BW * $1/AT_c$

$LADD_a$ = 50 mg/d * 31.3 mg/kg * 250 d/y * 12 yr * 10-6 kg/mg * y/365 d * 1/70 kg * 1/70 yr
= 2.6E-6 mg/kg/day

1b. Ingestion Dose- PAHs

$LADD_c$ = 100 mg/d * 0.394 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/70 yr
= 1.4 E-7 mg/kg/day

$LADD_a$ = 50 mg/d * 0.394 mg/kg * 250 d/y * 12 yr * 10-6 kg/mg * y/365 d * 1/70 kg * 1/70 yr
= 3.3 E-8 mg/kg/day

2. Dermal Dose

Noncancer risk calculations shown above indicate that only a very small fraction (1% or less) of the total estimated dose comes from dermal pathway, and the vast majority of the dose comes from the ingestion pathway. For this reason, dermal exposures were not evaluated in the cancer risk calculations.

3a. Cancer Risk- Arsenic

ELCR $= LADD_c + LADD_a * CSF$

ELCR = 1.36 E-5 * 1.5 (mg/kg/day)-1

ELCR = 2 E-5

3b. Cancer Risk- PAHs

ELCR $= LADD_c + LADD_a * CSF$

ELCR = 1.7 E-7 * 7.3 (mg/kg/day)-1

ELCR = 1 E-6

The estimated Excess Lifetime Cancer Risk for arsenic is 2 E-5 (2 in 100,000). This means that if 100,000 people were exposed to arsenic in soil at the concentration, frequency and duration of exposure assumed in the calculation detailed above, there would be a theoretical increase of 4 cancers above the number of cancers that would normally be expected to occur in the population of 100,000. Background rates of cancer in the U.S. are one in 2 or 3(American Cancer Society, 1996). This means that in a population of 100,000, background numbers of cancer cases would be approximately 33,000 to 50,000. Arsenic exposures could result in a theoretical increase of 2 cancer cases above the background number of 33,000 to 50,000 cancer case. This represents a very low increased cancer risk.

The estimated Excess Lifetime Cancer Risk for PAHs is 1 E-6 (1 in 1,000,000). This means that if 1,000,000 people were exposed to PAHs in soil at the concentration, frequency and duration of exposure assumed in the calculation detailed above, there would be a theoretical increase of 1 cancer above the number of cancers that would normally be expected to occur in the population of 1,000,000. Background rates of cancer in the U.S. are one in 2 or 3 (American Cancer Society,1996). This means that in a population of 1,000,000, background numbers of cancer cases would be approximately 330,000 to 500,000. PAH exposures could result in a theoretical increase of 1 cancer case above the background number of 330,000 to 500,000 cancer case. This represents an insignificant increased cancer risk.

WHERE:

ADD_i = average daily dose from ingestion
ADD_d = average daily dose from dermal contact
$LADD_c$ = lifetime average daily dose from ingestion for child, aged 1-6 years
$LADD_a$ = lifetime average daily dose from ingestion for adult, aged 7-18 years
IR_c = soil ingestion rate for a child; 100 mg/day (EPA 1997, ATSDR 1993)*
IR_a = soil ingestion rate for an adult; 50 mg/day (EPA 1997, ATSDR 1993)*
AF = skin-soil adherence factor for central tendency residential child; 0.06 mg/cm^2-ev (EPA 1999)

ABS_d = Soil dermal absorption fraction
Arsenic: 0.03 (EPA 1999)
PAHs: 0.13 (EPA 1999)

SA_c = Skin surface area, 50th %ile hands, child aged 1-6; 358 cm^2 (EPA 1997)

[Soil] = soil concentration
Arsenic: 31.3 mg/kg (maximum concentration detected)
PAHs, noncancer calculation: 1.77 mg/kg (average for all PAHs in 'half courtyard' area, see Table B1)
PAHs, cancer calculation: 0.394 mg/kg (TEF-adjusted average for all PAHs in 'half courtyard' area, see Table B1)

EF = exposure frequency; 250 d/y (5 days/week, 50 weeks/year)

F = event frequency; 1 ev/d

ED = exposure duration; 6 years for noncancer, 18 years for cancer

C1 = conversion factor; 10-6 kg/mg

C2 = conversion factor; 1 year/365 days

BW_c = child 50th %ile body weight for age 1-6 yrs (ATSDR 1993); 16 kg

BW_a = adult 50th %ile body weight (ATSDR 1993); 70 kg

AT_{nc} = averaging time for noncancer risk; 6 years

AT_c = averaging time for cancer risk; 70 years

RfD = EPA Reference Dose
Arsenic: 3E-4 mg/kg/day (IRIS)
PAHs: naphthalene used as a surrogate for PAHs; 0.02 mg/kg/day (IRIS)

CSF = Cancer Slope Factor
Arsenic: 1.5$(mg/kg/d)^{-1}$ (IRIS)
PAHs: CSF for benzo(a)pyrene used with TEF-weighted PAH concentrations; 7.3 $(mg/kg/d)^{-1}$ (IRIS)

HI = Hazard Index; a measure of theoretical noncancer health risks

ELCR = Excess Lifetime Cancer Risk

** EPA (1997) recommends using soil ingestion rates of 100 mg/day for a child <6 years and 50 mg/day for a child/adult ≥ 6 years. EPA states that these values represent best estimates of average soil ingestion rates. EPA programs have used 200 mg/day and 100 mg/day as conservative estimates of average soil intake rates. CT DPH opted to use the best estimate average values of 100 mg/day and 50 mg/day rather than the more conservative estimates for the sake of consistency with other parameters describing the receptor which are also central estimates (for example, body weight, skin surface area and skin-soil adherence).*

TABLE B1. Values used to calculate average PAH concentrations for cancer and noncancer risk calculations.

PAH	TEF*	SS3		SS2		SS1		64		57	
		Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.
Benzo(a)anthracene	0.1	4.2	0.42	2.78	0.278	1.54	0.154	0.6	0.06	0.2	0.02
Benzo(b)fluoranthene	0.1	5.4	0.54	4.45	0.445	2.25	0.225	1.3	0.13	0.6	0.06
Benzo(a)pyrene	1	2.2	2.2	0.54	0.54	0.91	0.91	0.76	0.76	0.4	0.4
Indeno(123-cd)pyrene	0.1	2.93	0.293	2.42	0.242	1.37	0.137	0.5	0.05	0.2	0.02

TEF* = Toxic Equivalency Factor (ATSDR 1995)

Average detected concentration for all PAHs at all locations = 1.77 mg/kg (used for noncancer calculations)
Average TEF-adjusted concentration for all PAHs at all locations = 0.394 mg/kg (used for cancer calculations)

ATTACHMENT C

Supplementary Information on Health Effects from Exposure to Arsenic and PAHs

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry — September 1996

This fact sheet answers the most frequently asked health questions about polycyclic aromatic hydrocarbons. For more information, you may call 404-639-6000. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- ❑ PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- ❑ PAHs can occur in air attached to dust particles.
- ❑ Some PAH particles can readily evaporate into the air from soil or surface waters.
- ❑ PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- ❑ PAHs enter water through discharges from industrial and wastewater treatment plants.
- ❑ Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- ❑ Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- ❑ In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- ❑ PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- ❑ Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- ❑ Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- ❑ Coming in contact with air, water, or soil near hazardous waste sites.
- ❑ Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns. For more information, contact: Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333, Phone: 404-639-6000, FAX: 404-639-6315. ATSDR Internet home page via WWW is http://atsdr1.atsdr.cdc.gov:8080/atsdrhome.html

ATSDR

ARSENIC

Agency for Toxic Substances and Disease Registry **April 1993**

This fact sheet answers the most frequently asked health questions about arsenic. For more information, you may call 404-639-6000. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to higher than average levels of arsenic happens mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. Arsenic is a powerful poison. At high levels, it can cause death or illness. This chemical has been found in at least 781 of 1,300 National Priorities List sites identified by the Environmental Protection Agency.

What is arsenic?
(Pronounced ar′ sè - nik)

Arsenic is found in nature at low levels. It's mostly in compounds with oxygen, chlorine, and sulfur. These are called inorganic arsenic compounds. Arsenic in plants and animals combines with carbon and hydrogen. This is called organic arsenic. Organic arsenic is usually less harmful than inorganic arsenic.

Most arsenic compounds have no smell or special taste.

Inorganic arsenic compounds are mainly used to preserve wood. They are also used to make insecticides and weed killers. You can check the labels of treated wood and insecticides to see if they contain arsenic.

Copper and lead ores contain small amounts of arsenic.

What happens to arsenic when it enters the environment?

- ❑ It doesn't evaporate.
- ❑ Most arsenic compounds can dissolve in water.
- ❑ It gets into air when contaminated materials are burned.
- ❑ It settles from the air to the ground.
- ❑ It doesn't break down, but can change from one form to another.
- ❑ Fish and shellfish build up organic arsenic in their tissues, but most of the arsenic in fish isn't toxic.

How might I be exposed to arsenic?

- ❑ Breathing sawdust or burning smoke from wood containing arsenic
- ❑ Breathing workplace air
- ❑ Ingesting contaminated water, soil, or air at waste sites
- ❑ Ingesting contaminated water, soil, or air near areas naturally high in arsenic.

How can arsenic affect my health?

Inorganic arsenic is a human poison. Organic arsenic is less harmful.

High levels of inorganic arsenic in food or water can be fatal. A high level is 60 parts of arsenic per million parts of food or water (60 ppm). Arsenic damages many tissues including nerves, stomach and intestines, and skin. Breathing high levels can give you a sore throat and irritated lungs.

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Lower levels of exposure to inorganic arsenic may cause:

- Nausea, vomiting, and diarrhea
- Decreased production of red and white blood cells
- Abnormal heart rhythm
- Blood vessel damage
- A "pins and needles" sensation in hands and feet.

Long term exposure to inorganic arsenic may lead to a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Direct skin contact may cause redness and swelling.

How likely is arsenic to cause cancer?

The Department of Health and Human Services (DHHS) has determined that arsenic is a known carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver, and lung.

Is there a medical test to show whether I've been exposed to arsenic?

Tests can measure your exposure to high levels of arsenic. These tests are not routinely performed in a doctor's office.

Arsenic can be measured in your urine. This is the most reliable test for arsenic exposure. Since arsenic stays in the body only a short time, you must have the test soon after exposure.

Tests on hair or fingernails can measure your exposure to high levels of arsenic over the past 6-12 months. These tests are not very useful for low level exposures.

These tests do not predict whether you will have any harmful health effects.

Has the federal government made recommendations to protect human health?

The Environmental Protection Agency (EPA) sets limits on the amount of arsenic that industrial sources can release. It restricted or canceled many uses of arsenic in pesticides and may restrict more. EPA set a limit of 0.05 parts per million (ppm) for arsenic in drinking water. EPA may lower this further.

The Occupational Safety and Health Administration (OSHA) established a maximum permissible exposure limit for workplace airborne arsenic of 10 micrograms per cubic meter ($\mu g/m^3$).

Glossary

Carcinogen: Substance that can cause cancer.
Ingesting: Taking food or drink into your body.
PPM: Parts per million.
Microgram (µg): One millionth of a gram.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological profile for arsenic. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Case studies in environmental medicine: Arsenic toxicity. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns. For more information, contact: Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333, Phone: 404-639-6000.

ATTACHMENT D: ATSDR Public Health Hazard Categories

Category	Definition	Criteria
A. Urgent public health hazard	This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon short-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention AND/OR physical hazards at the site pose an imminent risk of physical injury
B. Public health hazard	This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon long-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention
C. Indeterminate public health hazard	This category is used for sites with incomplete information.	limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects; data or information are not available for all environmental media to which humans may be exposed AND there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health
D. No apparent public health hazard	This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.	exposures do not exceed an ATSDR chronic MRL or other comparable value AND data are available for all environmental media to which humans are being exposed AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health
E. No public health hazard	This category is used for sites that do not pose a public health hazard.	no evidence of current or past human exposure to contaminated media AND future exposures to contaminated media are not likely to occur AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health