

Health Consultation

Public Health Evaluation of Surface Soils in Rochford Field and Mill Rock Park
(a/k/a Rochford Field Annex)

ROCHFORD FIELD AND MILL ROCK PARK
(a/k/a ROCHFORD FIELD ANNEX)

HAMDEN, NEW HAVEN COUNTY, CONNECTICUT

EPA FACILITY ID:

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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

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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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HAMDEN, NEW HAVEN COUNTY, CONNECTICUT

Prepared by:

Connecticut Department of Public Health
Under a 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 (CTDPH) was asked by the Connecticut Department of Environmental Protection (CTDEP) and the Quinnipiac Valley Health District (QVHD) to evaluate the public health significance of surface soil contamination in two public parks (Rochford Field and Mill Rock Park) in Hamden, Connecticut.

The site that is the subject of this Health Consultation consists of a municipal park with playground (Mill Rock Park) and a baseball/soccer field (Rochford Field) in Hamden, CT. Rochford Field is approximately 4.84 acres in size and completely fenced with access through four gates. There are two baseball diamonds, a grandstand and a soccer field. The Field is grass covered. The grass is generally in good condition. Rochford Field is bound by Newhall Street to the west, Mill Rock Road to the north, Winchester Avenue to the east, and Newbury Street to the south. Residential properties abut Rochford Field to the north and south, residential properties and Mill Rock Park abut the Field to the east and Hamden Middle School abuts the site to the west (Figure 1 in Attachment A).

Mill Rock Park is approximately 2.94 acres in size and is bounded by Winchester Avenue to the west, Mill Rock Road to the north, Wadsworth Street to the east, and residential properties on Bryden Terrace to the south. Mill Rock Park is not completely fenced in and contains children's play equipment, two tennis courts, a basketball court, a paved area and park benches. The playground equipment in Mill Rock Park is surrounded by sand. Rochford Field and Mill Rock Park are owned and maintained by the town of Hamden.

According to CTDEP's review of historical photos and other information, Rochford Field and Mill Rock Park were acquired by the town of Hamden in the late 1930s. According to 1934 aerial photographs, the site and much of the surrounding area was occupied by a wetland. Photographs published in 1939 show the site as a "public dump." According to a resident of the community, the site was allegedly used as a >coke lot= (area with coal waste byproducts from industrial processes) by the Winchester Repeating Arms company prior to being developed for recreation purposes. The baseball fields at Rochford Field were constructed in 1939 (DEP 2001).

In late 2000, after soil contamination and landfill wastes were discovered at the adjacent Hamden Middle School, CTDEP began a series of soil sampling activities at Rochford Field and Mill Rock Park. The sampling indicated the presence of elevated arsenic and polycyclic aromatic hydrocarbons (PAHs) in surface and subsurface soils. In April 2001, Rochford Field was temporarily closed while the town performed additional sampling and interim clean up actions which consisted of capping bare soil areas with asphalt. Rochford Field was reopened in September 2001.

This health consultation evaluates public health implications from exposure to contaminants in surface soil that are present at levels above health protective screening values. For those contaminants present above screening values, exposures and health risks are assessed and public health implications are discussed.

Site Visit

CTDPH staff have conducted several visits to Rochford Field and Mill Rock Park. CTDPH visited the site in February 2001 to observe the condition of the Field and CTDEP sample locations. In April 2001, CTDPH visited the site to assist in selecting sample locations in conjunction with the interim remedial action performed by the Town of Hamden. In September 2001, a site visit occurred to observe the Field after completion of the interim remedial action at the time the Field was reopened. In September 2002, CTDPH staff visited the site again to observe the condition of the Field. It was observed that the grass has worn away in some areas, particularly in the soccer goal areas.

Demographics

There are approximately 42 homes with approximately 100 residents who live adjacent to Rochford Field and Mill Rock Park and thus have easy access to the Field and Park. In addition, there are approximately 1000 Hamden Middle School Students (aged 11-14 years) who may use Rochford Field for athletic activities during the school day. In addition, Hamden's youth soccer and baseball programs use Rochford Field for their activities. There may be as many as 400-600 children, aged 4-10 years, who participate in the Town soccer and baseball programs.

Environmental Contaminant Levels and Health Comparison Values

Rochford Field

Table 1 presents soil data from Rochford Field. In response to soil contamination and landfill waste discovered at Hamden Middle School in November 2000, CT DEP began investigating whether soil contamination and landfill materials were also present at Rochford Field. In December 2001, CT DEP collected 15 soil samples from a depth interval of 0-4 feet below ground surface (bgs). To characterize surface soils, CT DEP collected 14 soil samples (0-6 inches bgs) in January 2001. The surface and subsurface samples show the presence of arsenic and PAHs at elevated levels. In surface soils, arsenic is present at consistently elevated levels across the Field.

At the request of CT DPH, CTDEP collected additional data to better characterize the uppermost accessible surface soil that people would be most likely to come into direct contact with at the Field. This consisted of 20 surface soil samples from 0-2 inches and 18 samples from 2-6 inches bgs in March 2001. Finally, 41 samples were taken at 0-3 inches bgs in May 2001 as part of CT DEP's effort to identify areas of the Field that needed to be capped. It is important to note that the bare soil infields on the two baseball fields were sampled by CTDEP as part of this investigation and were found not to be contaminated.

As seen in Table 1, nearly all the surface soil samples in Rochford Field contain arsenic at concentrations that exceed CTRSRs (Connecticut Remediation Standard Regulations Direct Exposure Criteria). There appears to be no spatial pattern to the exceedances. CTRSRs are soil standards that were developed to be protective of children and adults who have contact with soils on

a daily basis for

many years (30 years). The maximum arsenic level is 59.7 mg/kg (0-6 inch sample, January, 2001). In two samples, lead levels exceeded CTRSRs. In addition, several samples contained PAHs (benzo(a)anthracene and benzo(b)fluoranthene) that exceeded CTRSRs.

TABLE 1: Surface Soil Sample results from Rochford Field, Hamden CT

Contaminant	Sample Depth	Sample Date	Concentration Range (mg/kg)	Number of Exceedances of Comparison Value	Comparison Value	Comparison Value Source
Arsenic	0-6"	1/2001	28.4-59.7	14/14	10	CTRSR*
	0-2"	3/2001	ND-42.8	18/20		
	2-6"	3/2001	ND-51.9	16/18		
	0-3"	5/2001	2.6-44.2	40/41		
Lead	0-3"	5/2001	36.6-940	2/41	500	CTRSR
	0-6"	1/2001	107-270	0/14		
	0-2", 2-6"	3/01	94 -214	0/38		
Benzo(a)anthracene	0-3"	5/2001	<0.17-8.1	3/41	1	CTRSR
Benzo(b)fluoranthene	0-3"	5/2001	<0.17-5.7	4/41	1	CTRSR

* CTRSR =Connecticut Remediation Standard Regulations Direct Exposure Criteria. These soil standards are developed to be protective of children and adults who have contact with soil on a daily basis for many years (30 years).

Mill Rock Park

In response to soil contamination at Hamden Middle School, CT DEP took eighteen initial soil samples at a depth interval of 0-4 feet bgs in December 2000 at Mill Rock Park. These results indicated PAH and arsenic contamination. To characterize surface soils, CT DEP collected ten surface soil samples in December 2000 at a depth of 0-6 inches bgs. At the request of CT DPH, CT DEP collected fifteen more samples at 0-6 inches bgs in January 2001. The sand underneath the play equipment was also tested and was not contaminated.

As seen in Table 2, the maximum arsenic level in Mill Rock Park was 31.3 mg/kg, but exceedances of the CTRSR for arsenic were relatively infrequent. Arsenic contamination is greater and more widespread in Rochford Field than Mill Rock Park.

Table 2 also shows PAHs that exceeded CTRSRs in Mill Rock Park. The maximum concentration of any PAH is 5.42 mg/kg (benzo(b)fluoranthene) which is approximately 5 times the CTRSR. There is no obvious spatial pattern to the PAH exceedances. About 45% of the samples with detectable levels of PAHs exceeded CTRSRs.

TABLE 2: Surface Soil Sample results from Mill Rock Park, Hamden CT

Contaminant	Sample Depth	Sample Date	Concentration Range (mg/kg)	Number of Exceedances of Comparison Value	Comparison Value (mg/kg)	Comparison Value Source
Arsenic	0-6"	12/2001	1.52-31.3	2/10	10	CTRSR*
		1/2001	3.52-28.85	3/15		
Benzo(a)anthracene	0-6"	12/2001	ND-4.27	5/10	1	CTRSR
		1/2001	ND-1.56	3/15		
Benzo(a)pyrene	0-6"	12/2000	ND-2.27	2/10	1	CTRSR
		1/2001	ND-1.34	3/15		
Benzo(b)fluoranthene	0-6"	12/2000	ND-5.42	5/10	1	CTRSR
		1/2001	ND-2.30	8/15		
Indeno(1,2,3-cd)pyrene	0-6"	12/2000	ND-2.93	5/10	1	CTRSR
		1/2002	ND-1.26	4/15		

* CTRSR =Connecticut Remediation Standard Regulations Direct Exposure Criteria. These soil standards are developed to be protective of children and adults who have contact with soil on a daily basis for many years (30 years).

DISCUSSION

Exposure Pathway Analysis

To evaluate potential exposures to soil contaminants in Mill Rock Park and Rochford Field, CTDPH evaluated the environmental data and considered how people might come into contact with contaminants in soil. The possible pathways of exposure are dermal (direct contact with soil), inhalation (breathing soil particles that have become airborne) and incidental ingestion (eating soil particles adhered to hands or food). In other words, in order to be exposed to contaminants in soil in Rochford Field and Mill Rock Park, one must come into contact with the soil by touching the soil, inhaling soil particles, or eating soil adhered to fingers or food items. Inhalation is not a major pathway because most of Rochford Field and Mill Rock Park is either paved or covered with grass which creates a very low potential for excessively dry and dusty soil conditions. Possible inhalation exposure could occur to people who routinely mow the lawn at the Park and Field but this pathway is considered to be very minimal. Potential dermal and ingestion exposures to soil are evaluated in detail in this health consultation.

There is some groundwater data from the nearby Hamden Middle School which indicates that groundwater has been impacted by contaminants in the landfill material. However, ingestion of groundwater contaminants is not a concern because drinking water is supplied by the municipal water system.

Both Mill Rock Park and Rochford Field are used year round by the town and the neighborhood for various recreational activities including baseball and soccer. Children and adults could be exposed to contaminants while playing or attending events in the Park or Field. In Rochford Field, areas where intense soil contact occurs are the baseball infields, which have been sampled and are not contaminated. Thus, direct contact with soil in the baseball infield areas would not result in exposure to contaminants. Other areas in Rochford Field are grass covered, which greatly minimizes the potential for direct contact with contaminated soil. There are some areas in Rochford Field, such as

the soccer goals, where the grass has been worn away. In Mill Rock Park, the most intensely used area is the play structure. Exposure to soil contaminants would not occur to children playing in this area because the sand beneath the play equipment is not contaminated.

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 health-based comparison values, we can say that 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. In this health consultation, CT DPH used Connecticut Remediation Standard Regulations direct contact residential soil standards (CTRSRs) as health protective screening values. As stated previously, these values are health-protective levels developed to protect children and adults from frequent, long-term exposure to contaminants in soil. Tables 1 and 2 indicate that arsenic, PAHs and lead were detected in soil at levels above CTRSRS. Therefore, exposures to these contaminants are evaluated in further detail in the remaining sections of this health consultation.

Public Health Implications

Rochford Field - Arsenic

In Rochford Field, arsenic was detected in nearly all of the samples at levels exceeding CTRSRS. The maximum arsenic concentration is almost six times the CTRSRS of 10 mg/kg. However, it is important to note that CTRSRS 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. Such frequent and intense contact with the soil in the area where arsenic was found at Rochford Field is unlikely because the frequency that people would visit the area would likely be less than 7 days per week, 365 days per year and the presence of grass significantly reduces the potential for direct contact with soil.

To evaluate more realistic exposures at Rochford Field, CT DPH did calculations to assess the doses and theoretical risks from exposure to arsenic, assuming that soil exposure occurs an average of 2 days per week, 52 weeks per year, for 30 years. CTDPH believes this is a realistic, yet still very health protective assumption given the specifics of the site. Both children and adult doses were calculated. CTDPH used a central tendency soil exposure point concentration because it is more representative of the concentration to which people would be exposed over the long term than the maximum concentration. CTDPH relied upon the 95% Upper Confidence Limit (UCL) of the mean (an estimate of the central tendency), calculated using ProUCL (EPA, May 2001). A 95% UCL accounts for variability in the data and ensures that the mean is not underestimated. Given the assumptions about exposure frequency and duration and a 95% UCL exposure level of 34.26 mg/kg of arsenic, the average daily dose from ingestion and dermal contact was estimated to be 6.46 E-5 mg/kg/day. This dose is well below the Agency for Toxic Substances and Disease Registry's (ATSDR's) Minimum Risk Level (MRL) for chronic oral arsenic exposure of 3 E-4 mg/kg/day. MRLs are estimates of daily exposure to humans that are likely to be without harmful noncancer effects. Because the dose from the site is less than the MRL, harmful effects from arsenic in soil at Rochford Field are unlikely. See Attachment B for the detailed calculations.

Because arsenic can be an acute (short-term) toxin, CT DPH also calculated an acute ingestion dose for a 2-year old child assuming a soil ingestion rate of 400 mg/day over a 7-day period. This ingestion rate is four times higher than the ingestion rate used for the longer term dose and risk calculations described above. The acute calculation focused on a young child because younger children are more likely to ingest soil than older children. As shown in Attachment B, the acute dose from the site is less than ATSDR's Acute MRL. Thus, adverse health effects from acute oral exposure to arsenic in the soil at Rochford Field are unlikely.

CT DPH also calculated a lifetime average daily dose (based on 30 years of exposure; age 1 to 30 years) and theoretical cancer risks from long-term exposure to arsenic. Detailed calculations are found in Attachment B. The theoretical cancer risk from arsenic exposure of $1E-5$ (one excess cancer per 100,000) represents a small incremental risk above the background cancer level of approximately one in three (NCI 2001). Additionally, the estimated lifetime average daily dose from arsenic exposure at Rochford Field ($8 E-6$ mg/kg/day) is much lower than the cancer effect level (CEL) which is the range of doses that have caused cancer in humans and animals. Cancer Effect Levels range from 0.0075-0.064 mg/kg/day for skin cancer, 0.0011-0.064 mg/kg/day for lung cancer, and 0.033-3.67 mg/kg/day for bladder cancer (ATSDR Toxicological Profile, 2000). Because the average daily dose from the site is much lower than the CEL for oral arsenic exposure, cancer effects are unlikely.

Another factor to consider in putting arsenic soil concentrations in Rochford Field into perspective is how the levels compare with background. Background levels of arsenic in soil range from about 1 to 40 mg/kg, with an average of about 5 mg/kg. Arsenic in soil may originate from the parent materials that form the soil, industrial wastes, or use of arsenical pesticides (ATSDR Toxicological Profile, 2000). The majority of samples from Rochford Field are at the upper end of the range of the background for arsenic and some of them exceed these levels.

Rochford Field - PAHs

As shown in Table 1, there are two PAHs (benzo(b)fluoranthene and benzo(a)anthracene) which exceed CTRSRs, albeit infrequently. While the maximum concentration for a single PAH is 8.1 mg/kg, average concentrations (as estimated by the 95% UCL) are only slightly greater than CTRSRs. As previously discussed, CTRSRs are developed to protect children and adults who come into direct contact with soil every day over the long-term. Exposures at Rochford Field are likely to be much less than exposures assumed in developing the CTRSRs because the frequency that people would visit Rochford Field is likely to be less and the presence of grass will minimize direct contact with soil. It should also be noted that PAH concentrations at Rochford Field are well within ranges of typical background for PAHs in soil. The Table in Attachment C presents typical background ranges for some PAHs. Automobile and diesel emissions, tire wear and asphalt are major sources of PAHs in soil, especially near roadways. 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. Based on all of these considerations, CTDPH has determined that adverse health impacts from PAHs in soil at Rochford Field are very unlikely.

Rochford Field - Lead

Lead was detected in soil at Rochford Field very infrequently. As shown in Table 1, only two out of almost 100 samples contained lead at levels above the CTRSR of 500 mg/kg. However, an average concentration provides a more realistic estimate than a maximum concentration of what people are likely to be exposed to over the long term. The average lead level in Rochford Field (as estimated by the 95% UCL) is well below the CTRSR of 500 mg/kg. Therefore, CTDPH concludes that exposures to lead in soil at Rochford Field do not pose a health concern.

Mill Rock Park - Arsenic

As shown in Table 2, arsenic contamination in Mill Rock Park occurs infrequently and contaminant levels are seldom above CTRSRs. The 95% UCL for arsenic in Mill Rock Park (7.45 mg/kg) is below the CTRSR of 10. Thus, CTDPH concludes that exposures to arsenic at Mill Rock Park do not present a health concern.

Mill Rock Park - PAHs

Table 2 indicates that several PAHs are present in Mill Rock Park at levels exceeding CTRSRs. As stated above, CTRSRs were developed to be protective of young children and adults exposed to soil every day over the long term. It is unlikely that such frequent and intense soil exposure would occur at Mill Rock Park because the frequency that people would visit the Park is likely to be lower and the presence of grass would minimize direct contact with soil. To evaluate more realistic exposures for children and adults who may come into contact with soils at Mill Rock Park, CTDPH assumed that contact with soil occurs an average of 2 days per week, 52 weeks per year for 30 years. For an exposure point concentration, CTDPH relied on a 95% UCL. For cancer risk calculations, CTDPH adjusted the 95% UCL for each PAH by its respective Toxic Equivalency Factor (TEF) and summed the results to get a total TEF-adjusted exposure point concentration. The EPA cancer potency factor for benzo(a)pyrene was used to calculate theoretical cancer risks. For noncancer risk calculations, CTDPH calculated a 95% UCL for total PAHs and used the EPA oral Reference Dose for naphthalene. Detailed calculations are provided in Attachment B.

Attachment B shows that cancer and noncancer risks from exposure to PAHs in Mill Rock Park are not significant. PAH doses from Mill Rock Park are well below the EPA Reference Dose (safe dose) for noncancer health effects. Theoretical cancer risks from PAH exposure at Mill Rock Park are also very low (roughly 2 excess cancers in one million exposed) and represent a very small incremental risk above background. PAH concentrations at Mill Rock Park are also within the range of typical urban background (see the Table in Attachment C). Thus, CTDPH concludes that exposures to PAHs at Mill Rock Park do not present a health concern.

Attachment D provides information on health impacts from exposure to high levels of arsenic, PAHs and lead. This is provided for general information purposes and not to imply that these effects would be expected from exposure at this site.

EVALUATION OF COMMUNITY HEALTH CONCERNS

Community concerns were collected at four public meetings and two public availability sessions that were held between January and June 2002 in the Newhallville neighborhood. CTDPH staff attended each of these public forums. Concerns were also collected during home visits with residents in the neighborhood surrounding Rochford Field and Mill Rock Park who had their yards sampled by EPA to determine whether hazardous contaminants from the landfill were present in residential surface soils. Community concerns collected by CTDPH are summarized below. A response to each concern is provided as well.

1. Parents of children who play sports at Rochford Field are concerned about the health and safety of their children.

Children who play sports at Rochford Field are very unlikely to experience adverse health impacts from exposure to contaminants in soil. Most of the Field has a grassy cover which provides an added barrier to the contaminated soil. The bare infields in the baseball fields in Rochford Field are not contaminated.

2. Parents of children who live immediately adjacent to Rochford Field and Mill Rock Park state that their children use the Field and Park everyday and they are concerned about whether they should continue to allow their children to play there.

Even children who visit the Field and Park everyday are very unlikely to experience adverse health impacts. Parents may continue to allow their children to play in the Park and Field. Children should observe ordinary cleanliness practices when playing in the Park and Field such as washing their hands before eating.

3. Parents of young children want to know if the playground is safe for their children.

The playground is safe for children. Sand beneath the play equipment is not contaminated. The grassy area adjacent to the play equipment has some arsenic and PAHs, but the levels are not consistently high and the grass provides a barrier to direct contact with soil.

4. Some residents expressed concern that Rochford Field and Mill Rock Park should remain closed until all the landfill waste is removed from beneath the Park and Field.

Exposure is not likely to occur to waste present at depth unless digging occurs. CTDPH recommends no digging at Rochford Field and Mill Rock Park. It may be many years before a decision is reached about what will be done with the landfill waste present beneath Rochford Field and Mill Rock Park. It is not necessary to restrict access to the Field and Park until a cleanup decision is reached provided that digging does not occur.

5. Some residents state that they played in Rochford Field and Mill Rock Park when they were young. These residents wondered what exposures they might have received and whether exposures could have resulted in adverse health impacts.

CTDPH has evaluated all of the available environmental data and the ways people could have come into contact with contamination at Rochford Field and Mill Rock Park and have concluded that past exposures are unlikely to have caused adverse health impacts.

6. Residents say that their children recently played soccer on Rochford Field when there were bare areas with no grass and they are concerned about exposure and potential health impacts.

In Rochford Field, arsenic is the primary contaminant. CTDPH has evaluated exposures from short term (acute) exposure to arsenic in soil and found that such exposures were unlikely to pose a health concern. CTDPH has recommended that the town be more vigilant with maintaining the grass or other barrier to soil contact at Rochford Field, especially in the soccer field area

CONCLUSIONS

Surface soil samples taken around Rochford Field and Mill Rock Park show the presence of some PAHs and arsenic. At a few locations in Mill Rock Park, PAH, and arsenic concentrations exceed very conservative health-based comparison values that were developed to be protective of frequent, long-term contact with soil by young children. At most locations in Rochford Field, arsenic concentrations exceeded comparison values and in a few locations, PAHs exceed these values. However, it must be emphasized that there is very little opportunity for direct contact with contaminated soil at Rochford Field or Mill Rock Park. Most of the Field and Park are covered with grass which provides a protective barrier from direct contact with soil. The baseball diamonds in Rochford Field and the area beneath the play equipment in Mill Rock Park provide great opportunity for direct contact with soil, however, *contamination is not present in those areas.*

CT DPH did calculations of the doses and theoretical risks from exposure to arsenic and PAHs using realistic assumptions concerning exposure. These exposures are not likely to pose a health threat because average daily doses are below doses that have resulted in adverse noncancer health impacts. Theoretical cancer risks from exposure to contaminants in Rochford Field and Mill Rock Park present only a tiny incremental risk above background. In addition, as stated above, most of the Field and Park are covered with grass which provides a barrier to direct contact with soil.

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 E to this report. CT DPH has concluded that based on current information and under current conditions, the surface soils around Rochford Field and Mill Rock Park present no apparent public health hazard.

RECOMMENDATIONS

1. CT DPH recommends that the town of Hamden continue to maintain the grass on Rochford Field and Mill Rock Park which serves as a protective barrier from contaminant exposure. In addition, CT DPH recommends that grass be maintained or some other barrier to direct contact with soil be used in the high activity areas of the Field such as the soccer goal areas in Rochford Field. Grass should also be watered as needed to prevent the creation of dry, dusty soil conditions.
2. CTDPH recommends no digging in Rochford Field and Mill Rock Park because the depth of contamination is not fully characterized.

PUBLIC HEALTH ACTION PLAN

Actions Taken

1. CTDPH has participated in several public meetings and public availability sessions as well as provided information to residents about exposure and health impacts.
2. CTDPH has provided assistance to the QVHD in responding to health questions and concerns.

Actions Planned

1. CT DPH will make this health consultation available to community members in the Hamden Middle School area.
2. CT DPH will continue to participate in public meetings regarding contamination at the Hamden Middle School and surrounding sites, including Rochford Field and Mill Rock Park.
3. CT DPH will work with CT DEP and the local health departments to respond to health questions and concerns regarding hazardous contaminants at Rochford Field and Mill Rock Park.

REFERENCES

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CERTIFICATION

The Health Consultation for Public Health Evaluation of Surface Soils in Rochford Field and Mill Rock Park (a.k.a. Rochford Field Annex) 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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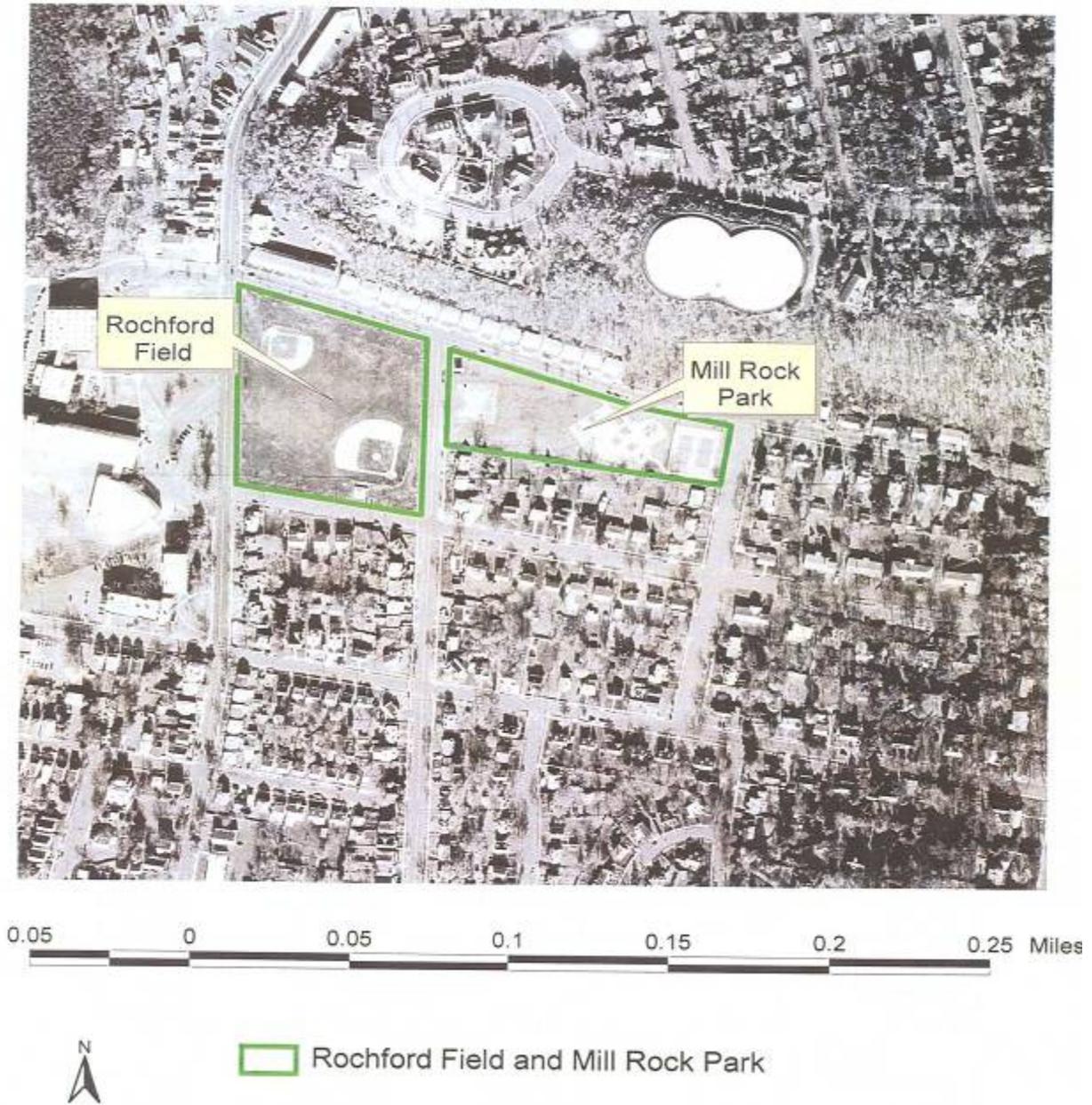
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ATTACHMENT A

Figure 1
Rochford Field and Mill Rock Park
Hamden Connecticut
November 2002



Attachment B: Exposure Dose and Theoretical Risk Calculations

The exposure assumptions made in these risk calculations are realistic, yet health protective. These risk calculations are done to assess the magnitude of theoretical risks.

Rochford Field

A. Noncancer risks, child aged 1-6 years

1a₁. Ingestion Dose-Arsenic

In this calculation, we are estimating the average daily dose of arsenic a child, age 1-6 years would receive from incidental ingestion of soil.

$$ADD_i = IR_c * [Soil] * EF * ED * C1 * C2 * C3 * 1/BW_c * 1/AT_{nc}$$

$$\begin{aligned} ADD_i &= 100 \text{ mg/d} * 34.26 \text{ mg/kg} * 365 \text{ d/y} * 6 \text{ y} * 2/7 \text{ (days pr week)} * 10^{-6} \text{ kg/mg} * \text{y} / 365 \text{ d} * 1/16 \text{ kg} * 1/6 \text{ yr} \\ &= 6.1 \text{ E-5 mg/kg/ day} \end{aligned}$$

1a₂. Acute Ingestion dose for a child, aged 2 years.

In this calculation, we are estimating the average daily dose of arsenic a child, aged 2 years would receive from incidental ingestion of soil, assuming a large ingestion rate over a short period of time (7 days).

$$\begin{aligned} ADDA_i &= IR_p * [Soil] * EF * ED * C1 * C4 * C5 * 1/BW_p * 1/AT_p \\ &= 400 \text{ mg/day} * 34.26 \text{ mg/kg} * 10^{-6} \text{ kg/mg} * 7 \text{ d/w} * 1 \text{ w} * 1/13 \text{ kg} * 1/7 \text{ d} \\ &= 0.001 \text{ mg/kg/day} \end{aligned}$$

The acute ingestion dose for arsenic exposure for a child is 0.001 mg/kg/day. ATSDR's Acute Oral Maximum Risk Level for arsenic is 0.005 mg/kg/day which is higher than acute ingestion dose. Therefore, these acute doses are within safe levels and do not pose any significant health threat.

2a. Dermal Dose-Arsenic

In this calculation, we are estimating the average daily dose of arsenic a child, age 1-6 years would receive through dermal contact.

$$ADD_d = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * C3 * 1/BW * 1/AT_{nc}$$

$$\begin{aligned} ADD_d &= 34.26 \text{ mg/kg} * .06 \text{ mg/cm}^2 / \text{-ev} * .03 * 3307 \text{ cm}^2 * 365 \text{ d/y} * 2/7 \text{ (days per week)} * 6 \text{ y} * 1 \text{ ev/d} \\ &* 10^{-6} \text{ kg/mg} * \text{y} / 365 \text{ d} * 1/16 \text{ kg} * 1/6 \text{ yr} \end{aligned}$$

$$ADD_d = 3.6 \text{ E-6 mg/kg/day}$$

3a. Noncancer Hazard Index-Arsenic

$$HI = ADD_i + ADD_d / RfD$$

$$HI = 6.1 \text{ E-5} + 3.6 \text{ E-6} / 3.4 \text{ E-4}$$

$$HI = 6.46 \text{ E-5} / 3 \text{ E-4 mg/kg/ day}$$

$$HI = 0.215$$

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 Index for arsenic is well below 1. This indicates that noncancer health impacts from arsenic are unlikely.

B. Cancer Risks, child/adult age 1-30

1b. Ingestion Dose-Arsenic

In this calculation, we are estimating the lifetime average daily dose of arsenic a child/adult, age 1-30 years would receive from ingestion of soil.

$$LADD_c = IR_c * [Soil] * EF * ED * C1 * C2 * C3 * 1/BW * 1/AT_c$$

$$LADD_c = 100 \text{ mg/d} * 34.26 \text{ mg/kg} * 365 \text{ d/y} * 6 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 2/7 \text{ (days per week)} * 1/16 \text{ kg} * 1/70 \text{ yr} \\ = 5.2 \text{ E-6 mg/kg/day}$$

$$LADD_a = IR_a * [Soil] * EF * ED * C1 * C2 * C3 * 1/BW * 1/AT_c$$

$$LADD_a = 50 \text{ mg/d} * 34.26 \text{ mg/kg} * 365 \text{ d/y} * 24 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 2/7 \text{ (days per week)} * 1/70 \text{ kg} * 1/70 \text{ yr} \\ = 2.4 \text{ E-6 mg/kg/day}$$

2b. Dermal Dose-Arsenic

In this calculation, we are estimating the average daily dose of arsenic a child/adult, age 1-30 years would receive from dermal contact.

$$LADDD_c = [Soil] * AF * ABS_d * SAc * EF * ED * F * C1 * C2 * C3 * 1/BW * 1/AT_c$$

$$LADDD_c = 34.26 \text{ mg/kg} * .06 \text{ mg/cm}^2 \text{-ev} * 0.03 * 3307 \text{ cm}^2 * 365 \text{ d/y} * 2/7 \text{ (days per week)} * 6 \text{ y} * 1 \text{ ev/d} * 10^{-6} \text{ kg/mg} * \text{y}/365 \\ \text{d} * 1/16 \text{ kg} * 1/70 \text{ yr} \\ = 3.1 \text{ E-7 mg/kg/day}$$

$$LADDD_a = [Soil] * AF * ABS_d * SAc * EF * ED * F * C1 * C2 * C3 * 1/BW * 1/AT_a$$

$$LADDD_a = 34.26 \text{ mg/kg} * .06 \text{ mg/cm}^2 \text{-ev} * 0.03 * 3307 \text{ cm}^2 * 365 \text{ d/y} * 2/7 \text{ (days per week)} * 24 \text{ y} * 1 \text{ ev/d} * 10^{-6} \text{ kg/mg} * \text{y}/365 \\ \text{d} * 1/70 \text{ kg} * 1/70 \text{ yr} \\ = 2.9 \text{ E-7 mg/kg/day}$$

3b. Cancer Risk-Arsenic

$$ELCR = (LADD_c + LADD_a + LADDD_c + LADDD_a) * CSF$$

$$ELCR = (5.24 \text{ E-6} + 2.4 \text{ E-6} + 3.1 \text{ E-7} + 2.9 \text{ E-7}) * CSF$$

$$ELCR = 8.2 \text{ E-6 mg/kg/day} * 1.5 \text{ (mg/kg/day)}^{-1}$$

$$ELCR = 1.2 \text{ E-5}$$

The Estimated Lifetime Risk for arsenic is 1.2 E-5 (1.2 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 1.1 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 55,000. Arsenic exposures could result in a theoretical increase of 1.2 cancer cases above the background number of 33,000 to 50,000 cancer cases. This represents a very low increased cancer risk.

A. Noncancer risks, child aged 0-6 years

1a. Ingestion Dose-PAHS

In this calculation, we are estimating the average daily dose of PAHs a child, age 1-6 years would receive via ingestion of soil.

$$\begin{aligned} \text{ADD}_i &= 100 \text{ mg/d} * 5.01 \text{ mg/kg} * 365 \text{ d/y} * 6 \text{ yr} * 2/7 \text{ (days pr week)} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 1/16 \text{ kg} * 1/6 \text{ yr} \\ &= 8.95\text{E-}6 \text{ mg/kg/ day} \end{aligned}$$

2a. Dermal Dose-PAHS

In this calculation, we are estimating the average daily dose of arsenic a child, age 1-6 years would receive from dermal exposure to soil.

$$\text{ADD}_d = 5.01 \text{ mg/kg} * 0.06 \text{ mg/cm}^2 \text{-ev} * 0.13 * 3307 \text{ cm}^2 * 2/7 \text{ (days per week)} * 365 \text{ d/y} * 6 \text{ yr} * 1 \text{ ev/d} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 1/16 \text{ kg} * 1/6 \text{ yr}.$$

$$\text{ADD}_d = 2.3\text{E-}6 \text{ mg/kg/ day}$$

3a. Noncancer Hazard Index-PAHS

$$\text{HI} = 8.95\text{E-}6 + 2.3\text{E-}6 / .02 \text{ mg/kg/day}$$

$$\text{HI} = 1.13\text{E-}5 / .02 \text{ mg/kg/day}$$

$$\text{HI} = 5.6\text{E-}4$$

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, Health Indices for PAHs are well below 1. This indicates that noncancer health impacts from PAHs are unlikely.

B. Cancer Risks, child/adult age 6-30

1b. Ingestion Dose-PAHS

In this calculation, we are estimating the average daily dose of PAHs a child/adult, age 6-30 years would receive during ingestion of soil.

$$\begin{aligned} \text{LADD}_c &= 100 \text{ mg/d} * 1.23 \text{ mg/kg} * 365 \text{ d/y} * 6 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 2/7 \text{ (days per week)} * 1/16 \text{ kg} * 1/70 \text{ yr} \\ &= 1.9 \text{ E-}7 \text{ mg/kg /day} \end{aligned}$$

$$\begin{aligned} \text{LADD}_a &= 50 \text{ mg/d} * 1.23 \text{ mg/kg} * 365 \text{ d/y} * 24 \text{ yr} * 10^{-6} \text{ kg/mg} * \text{y}/365 \text{ d} * 2/7 \text{ (days per week)} * 1/70 \text{ kg} * 1/70 \text{ yr} \\ &= 8.6 \text{ E-}8 \text{ mg/kg/day} \end{aligned}$$

2b. Cancer Risk-PAHS

$$\text{ELCR} = \text{LADD}_c + \text{LADD}_a * \text{CSF}$$

$$\text{ELCR} = 1.9\text{E-}7 + 8.6 \text{ E-}8 * 7.3 \text{ (mg/kg/day)}^{-1}$$

$$\text{ELCR} = 2.0 \text{ E-}6$$

The Estimated Lifetime Risk for PAHs is 2 E-6 (2 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 2 cancers 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 550,000. Arsenic exposures could result in a theoretical increase of 2 cancer cases above the background number of 330,000 to 500,000 cancer cases. This represents an insignificant increased cancer risk.

WHERE:

- ADD_i = average daily dose from ingestion
- ADD_d = average daily dose from dermal contact
- ADD_a = average daily dose from acute ingestion
- 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
- LADDD_a = lifetime average dermal daily dose for child, aged 1-6 years
- LADDD_c = lifetime average dermal daily dose for child, aged 7-30 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)*
- Ir_{ac} = acute soil ingestion rate for a child (upper percentile) (EPA 1997)
- AF = skin-soil adherence factor for central tendency residential child;
0.06 mg/cm²-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 legs, feet, hands, and arms, child aged 1-6;
3307 cm² (EPA 1997)
- [Soil] = soil concentration;
Arsenic: 34.26 mg/kg (95% Upper Confidence Limit of the arithmetic mean)[#]
PAHs (noncancer calculation): 5.01 mg/kg (Total 95% UCL for all PAHs)
PAHs (cancer calculation): 1.23 mg/kg (Total TEF-adjusted 95% UCL for all PAHs)
- EF = exposure frequency; 365 days/year
- F = event frequency
- ED = exposure duration; 6 years for child, 24 years for adult
- C1 = conversion factor; 10⁻⁶ kg/mg
- C2 = conversion factor; 1 year/365 days
- C3 = conversion factor, 2 days/week
- C4 = conversion factor, 7days/week
- C5 = conversion factor, 1 week
- Bw_c = child 50th %tile body weight for age 1-6 yrs (ATSDR 1993); 16 kg
- Bw_a = adult 50th %tile body weight (ATSDR 1993); 70 kg
- Bw_{ac} = body weight 2 year old child (EPA 1997)
- AT_{nc} = averaging time for noncancer risk; 6 years
- AT_c = averaging time for cancer risk; 70 years
- AT_{ac} = average time for noncancer risk; 7 days
- 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/day)⁻¹ (IRIS)
PAHs: benzo(a)pyrene; 7.3 (mg/kg/day)-1 (IRIS)
- HI = Hazard Index
- CSF = Cancer Slope Factor

* EPA (1997) recommends using soil ingestion rates of 100 mg/day for child < 6 years and 50 mg/day 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).

ATSDR (2002) advises using the 95% upper confidence limit of the arithmetic mean. This was performed using Pro UCL (EPA May 2000). A 95% UCL accounts for the variability in the data and ensures that the mean is not underestimated.

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

PAH	95% UCL (mg/kg)	Toxic Equivalency Factor(TEF)	TEF Adjusted Concentration (mg/kg)
Benzo(a)anthracene	1.29	0.1	0.129
Benzo(b)fluoranthene	1.86	0.1	0.186
Benzo(a)pyrene	0.81	1	0.81
Indeno(1,2,3-cd)pyrene	1.05	0.1	0.105
Total of 95% UCLs	5.01	---	1.23

ATTACHMENT C

Typical Urban Soil Background Levels for PAHs*

Contaminant	Background Level (mg/kg)
Benzo(a)anthracene	0.17-59
Benzo(b)fluoranthene	15-62
Benzo(a)pyrene	0.06-14
Indeno(1,2,3-cd)pyrene	8-61

*ATSDR 1995.

ATTACHMENT D

HEALTH EFFECTS BACKGROUND INFORMATION

ATTACHMENT E
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