Health Consultation

Arsenic in Soils

WPSC RIVER DRIVE PROPERTY
WAUSAU, WISCONSIN

Prepared by the
Wisconsin Department of Health Services

SEPTEMBER 28, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

Arsenic in Soils

WPSC RIVER DRIVE PROPERTY
WAUSAU, WISCONSIN

Prepared By:

Wisconsin Department of Health Services
Division of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary and Statement of Issues

The Wisconsin Division of Pubic Health (DPH) recognizes your need for more information about arsenic in soils. Our primary objective at the Wisconsin Public Service Corporation (WPSC) River Drive Property is to provide you with the necessary tools and information you need to protect your health.

In April 2009, the Wisconsin Division of Public Health (DPH) was requested by the Marathon County Health Department (MCHD) to assess the human health implications of soil contamination at the WPSC Property at 390 River Drive, Wausau, Marathon County, Wisconsin. MCHD's concern is primarily related to elevated arsenic levels in surface and sub-surface soils and the potential exposures to the public related to various current uses of this property.

The current and most frequent warm weather seasonal use of the 14-acre WPSC property is for a twice-per-week Farmer's Market that draws the public to purchase locally grown produce and farm products. The Farmers Market is held on the bare sandy or graveled portion of the site. Most foods are kept off the ground however, wind does blow dust around. Another group also uses a well vegetated, grassy portion of the site, immediately west of the graveled area, for temporary (usually tent) camping for whitewater kayaking events held nearby. MCHD indicated that the City of Wausau also uses the property in the winter as a snow removal storage site. No drinking water supply wells are located on the WPSC property, and drinking water for area residents and businesses is supplied by the municipal water utility. No changes to the current WPSC property use are currently planned.

Conclusions	**DPH reached three important conclusions in the health consultation:**
Conclusion 1	DPH concludes that the levels of arsenic in the area used for the farmers market are not expected to harm people's health due to the interim measure of clean gravel fill covering the un-vegetated portion of the site.
Basis for conclusion	Currently there is no exposure to the arsenic containing soil and fill.
Next steps	Work with the city, DNR and WPSC to develop and implement a final cover and maintenance plan for the farmers market area of the WPSC property.

Conclusion 2	DPH can not conclude whether or not people could have been harmed in past years by breathing in dust and eating the produce from the farmers market. This is because the WPSC River Drive property has not been fully investigated to provide adequate data to conduct a complete assessment of the past health risks for breathing and eating produce coated with arsenic containing dust from before the area was covered with clean gravel.
Basis for conclusion	In order to reach a conclusion on past exposures, DPH needed air monitoring data and farmer's market produce sampling data for arsenic and these data were not collected. Due to the interim cover already in place and plans for a final cover, the data will not be collected in the future.
Conclusion 3	DPH concludes that the levels of arsenic at the west end of the WPSC property occasional used for camping are not expected to harm people's health.
Basis for conclusion	Because the area is well vegetated, and is only used for short stays.
Next steps	Develop an inspection and maintenance plan to ensure good vegetative cover remains in place to prevent exposure.
Conclusion 4	DPH concludes that the City of Wausau's use of the property in the winter as a snow removal storage site is not expected to harm people's health.
Basis for conclusion	Because this use of the property is not expected to cause people to come into contact with arsenic containing soil.

Data Review

DPH reviewed the recent site investigation report (Terracon 2008), which indicated that the WPSC Property site was occupied by Heineman Lumber Company from 1923 to 1952. All buildings were removed from the site by 1952 and the site has remained vacant until present day. In general it is believed that fill from past lumber operations was placed along most of the riverfront. The fill originated from several sources including sawdust and chips from the lumber and milling operations historically prevalent in the area. Additional fill materials reportedly originated from Minnesota Mining and Manufacturing (3M) shingle manufacturing operations. Other properties in the vicinity of the WPSC Property site have been historically filled with dry zinc-carbon battery debris thought to have originated from the Marathon Battery operations. Immediately to the east of WPSC is the Hadley Office Products site, which was closed with a deed restriction and cap maintenance plan due to soils with elevated concentrations of arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs).

In May 2008, Terracon installed 43 push probes and three hand augers on the WPSC property in a grid across the site and collected soil samples from 0.5, 2, and 4 feet below ground surface. The soil samples were analyzed for lead and arsenic. The highest arsenic concentration was 72.9 mg/kg from 4 feet below ground surface (BGS). The highest arsenic concentration found at 0.5 feet BGS was 14.4 mg/kg. The highest concentrations at either depth are over both the industrial and non-industrial residual contaminant levels published in Table 2 of DNR Code 720.11, of 1.6 and 0.039 mg/kg, respectively (Legislative Reference Bureau 2009) set for carcinogenic effects. The Wisconsin Department of Natural Resources (DNR) indicated that the likely background levels of arsenic in soil in the area are a maximum of 5 to 6 mg/kg (milligrams per kilogram).

Discussion

When evaluating the potential health risks at a site, DPH often uses the screening values found in the US EPA Region III Risk-based concentration tables (EPA Region III 2009). For a known human carcinogen, such as arsenic, the screening values in the table are calculated to represent a theoretical excess cancer risk of one in one million based on certain default exposure assumptions. For arsenic, the residential soil exposure screening value is 0.39 mg/kg and the industrial soil screening value is 1.6 mg/kg. However, no true surface soils have been collected and analyzed, so the exposure to surface soils is estimated based on the maximum 0.5 foot arsenic levels. The highest soil concentrations found at WPSC, even at the 0.5 foot depth, exceed these screening levels for carcinogenic effects. These levels are, however, below both the adult (200 mg/kg) and child (20 mg/kg) screening values in soil for non-cancer effects (ATSDR 2007). On May 14, 2009, as an interim measure, the city covered the un-vegetated portion of the WPSC used for the farmers market with clean gravel.

Table 1 Arsenic in Soil Results, WPSC Property, Wausau

Maximum Arsenic Result			*Comparison Values*					
Sample Depth			NR 720 Direct Contact Residual Contaminant Level		ATSDR Chronic EMEG (non-cancer)		EPA Region III RBC	
0.5 ft	2 ft	4 ft	Non-Industrial	Industrial	Child	Adult	Residential	Industrial
14.4	12.6	72.9	0.039	1.6	20	200	0.39	1.6

All concentrations in mg/kg

Exposure Pathways Evaluation

Exceeding a screening value is not an immediate indication that people will get sick from the arsenic levels found in surface soils at WPSC property, but rather that further study may be warranted and that efforts may be needed to limit people's exposures. The current uses of the property do not result in any contact with sub-surface soils. So the potential for exposure to surface soils, using the highest levels found at the 0.5 foot depth is evaluated here.

The winter use of the WPSC property as a snow removal storage site is not now, nor in the past, likely to have resulted in exposure to the arsenic contaminated surface soils. Similarly, the occasional summer use by tent campers on the well vegetated grassy portion of the site is not likely to result in significant exposure to the arsenic contaminated soil, though dust from the un-vegetated portion of the site may have contributed a limited exposure to campers in past years before the interim measure of bringing in clean gravel to cover this area was done this spring. The most potentially exposed were the farmer's market users of the un-vegetated portion of the WPSC property during warm weather months in past years. Exposure to the arsenic contaminated soil on the WPSC property may have occurred through three routes. Soil may have been inadvertently ingested (by hand to mouth), arsenic contaminated dust from the bare soil/gravel may have been inhaled, and dust containing arsenic may have settled on the Farmer's Market food goods and been ingested.

The default exposure assumptions contained in either the residential or industrial screening value calculations likely need to be modified to calculate the past exposures on the WPSC property. The default residential exposure calculation assumes an individual is on the property 350 days per year, and the industrial calculation assumes a worker is on the property 250 days per year. The Farmer's Market vendors are likely on the WSPC property only 50 days per year. This would tend to lessen the potential exposure to arsenic contaminated soil as compared to the default exposure assumptions. However, the inhalation of dust, and the ingestion of food from the Farmer's Market may increase the exposure as compared to the default assumptions used in the screening value. Currently, there is a lack of data to evaluate the past potential exposure resulting from arsenic contaminated dust settling on Farmer's Market food stuffs. And thus, the total past increased potential risk from all pathways of the arsenic contaminated soil can not be accurately quantified.

Toxicological Implications of Ingesting Arsenic

Consumption of inorganic arsenic can cause many adverse health effects and long-term exposure to elevated arsenic levels in drinking water is known to increase risks of skin, bladder, lung, liver, colon, and kidney cancer (ATSDR 2007). EPA has classified inorganic arsenic as a "human carcinogen" based on sufficient evidence from a number of human studies and has calculated a reference dose of $3x10^{-4}$mg As/kg/day (EPA 1995). While, as indicated above, the past increased potential risk from all pathways of the arsenic contaminated soil can not be accurately quantified at the WPSC property, a comparison of default incidental ingestion assumptions to the industrial comparison values suggests a 1-in-100,000 theoretical increased excess lifetime cancer risk.

Arsenic has been extensively studied and many other adverse health effects, including blood vessel damage, high blood pressure, nerve damage, anemia, and skin changes are known to be associated with the ingestion of higher levels of inorganic arsenic. Stomach ache, nausea, vomiting and diarrhea often become detectable at doses above 0.01 mg As/kg/day. Oral exposure data from population studies indicate that skin lesions typically begin to manifest at arsenic exposure levels between 0.002 and 0.02 mg/kg/day. The relationship between inorganic arsenic exposure and other health effects is less clear. Some recent studies have linked arsenic with Type 2 diabetes mellitus. In a study of US adults exposed to arsenic in drinking water, Navas-Acien (2008) found that total urine arsenic was associated with an increased prevalence of type 2 diabetes. Coronado-González (2007) conducted a case-control study in Mexico of 400 participants whose drinking water sources contained 20-400 μg/L inorganic arsenic. Inorganic arsenic exposure was associated with an increased risk of diabetes.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

Children are exposed to arsenic in many of the same ways that adults are. Since children tend to eat or drink less of a variety of foods and beverages than do adults, ingestion of contaminated food or juice or infant formula made with arsenic-contaminated water may represent a significant source of exposure. Children who are exposed to inorganic arsenic may exhibit many of the same adverse health effects as adults, including irritation of the stomach and intestines, blood vessel damage, skin changes, and reduced nerve function. Prenatal and early childhood exposures to arsenic can increase the risk of lung cancer and respiratory disease in later life. There is some evidence that exposure to arsenic in early life (including gestation and early

childhood) may increase mortality in young adults. There is also some evidence that suggests that long-term exposure to inorganic arsenic may result in lower IQ scores.

Conclusions

For the arsenic found in the soil at the WPSC property at levels above likely background concentrations for the area, DPH reached four important conclusions:

DPH concludes that the levels of arsenic in the area used for the farmers market are not expected to harm people's health due to the interim measure of clean gravel fill covering the un-vegetated portion of the site. DPH can not conclude whether or not people could have been harmed in past years by breathing in dust and eating the produce from the farmers market. This is because the WPSC River Drive property has not been fully investigated to provide adequate data to conduct a complete assessment of the past health risks for breathing and eating produce coated with arsenic containing dust from before the area was covered with clean gravel.

DPH concludes that the levels of arsenic at the west end of the WPSC property occasionally used for camping are not expected to harm people's health, because the area is well vegetated, and is used for only short stays.

DPH concludes that the City of Wausau's use of the property in the winter as a snow removal storage site is not expected to harm people's health.

DPH concludes that the City of Wausau's use of the property in the winter as a snow removal storage site is not expected to harm people's health. This is because this use of the property is not expected to cause people to come into contact with arsenic containing soil.

Recommendations

In follow-up to the interim action of clean gravel fill covering the area used for the farmers market, DHS recommends the following actions:

- Working with the city, DNR and WPSC to develop and implement a final cover and maintenance plan for the farmers market area of the WPSC property.

- If a final cover and maintenance plan is not implemented, further site investigation is necessary to gather sufficient data to adequately evaluate the potential past and future exposures.

- Other less heavily used areas of the WPSC property should be inspected on a regular basis to insure that vegetative cover remains in good shape.

Public Health Action Plan

The public health action plan (PHAP) identifies actions that have been or will be taken by public health agencies for the WPSC River Drive Property. The PHAP ensures that public health hazards have been identified and that a plan of action is established to halt or prevent unsafe exposures to hazardous substances in the environment.

Actions that have been taken by agencies for this site include:

- DPH was requested by MCHD to assess the WPSC River Drive property with arsenic in surface soil above screening and area background levels.
- DPH reviewed existing site data and could not conclude whether or not people might be harmed by the arsenic in the soil in the area seasonally used for a farmer's market due to a lack of appropriate data.
- MCHD and DNR meet with city officials and WPSC representatives and WPSC decided to place an interim cap on the exposed soil in the area used by the farmer's market.
- City officials brought in new gravel on May 14, 2009 to cover the bare area before the seasonal use as a farmer's market began. This is an interim measure.

Current and future actions to be implemented by agencies are:

- DNR has requested that the WPSC prepare a maintenance plan for the interim cap.
- DNR has requested that plans for a final cover and a maintenance plan for the final cover be submitted to DNR, MCHD and DPH.

Authors, Technical Advisors

Bruce Rheineck, Research Scientist
Bureau of Environmental and Occupational Health
Division of Public Health
Wisconsin Department of Health Services

ATSDR Regional Representative
Mark Johnson
Division of Regional Operations, Region V
ATSDR

ATSDR Technical Project Officer
Jennifer Freed
Cooperative Agreement and Program Evaluation Branch
Division of Health Assessment and Consultation
ATSDR

References

ATSDR. 2007. Toxicological Profile for Arsenic – Update. Agency for Toxic Substances and Disease Registry, Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Available at URL: http://www.atsdr.cdc.gov/toxpro2.html.

Coronado-González JA, Del Razo LM, García-Vargas G, Sanmiguel-Salazar F, Escobedo-de la Peňa J. 2007. Inorganic arsenic exposure and type 2 diabetes mellitus in Mexico: Environmental Research 104, pg. 383-389.

EPA. 1995. Arsenic, inorganic (CASRN 7440-38-2) on the Integrated Risk Information System (IRIS). Available at URL: http://www.epa.gov/ncea/iris/subst/0278.htm

EPA Region III. May 19, 2009. Risk-Based Concentration Table
Available at URL: http://www.epa.gov/reg3hwmd/risk/human/index.htm

Knobeloch Lynda. June 2002. Health Effects of Arsenic-Containing Groundwater: Madison, Wisconsin: Department of Health and Family Services.

Legislative Reference Bureau. 2009. Electronic reproduction of Wisconsin Administrative Code, updated and current through July 2009 NR 720. Internet:
http://www.legis.state.wi.us/rsb/code/nr/nr720.pdf

Navas-Acien A, Silbergeld EK, Pastor-Barriusso R, Guallar E. 2008. Arsenic exposure and prevalence of type 2 diabetes in US adults: Journal of the American Medical Association, 300(7): 845-846.

Terracon, July 15 2008, Limited Site Investigation WPSC Property River Drive Wausau, WI State of Wisconsin,

CERTIFICATION

This Health Consultation for Arsenic in Soils – WPSC Property was prepared by the Wisconsin Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved methodology and procedures existing at the time the Health Consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

Jennifer Freed
Technical Project Officer
CAT, CAPEB, DHAC, ATSDR

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

Alan Yarbrough
Team Leader
CAT, CAPEB, DHAC, ATSDR