Health Consultation

Evaluation of Sample Data from Annapolis Yards

ANNAPOLIS LEAD MINE
ANNAPOLIS, IRON COUNTY, MISSOURI

EPA FACILITY ID: MO0000958611

NOVEMBER 16, 2007

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.

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

HEALTH CONSULTATION

Evaluation of Sample Data from Annapolis Yards

ANNAPOLIS LEAD MINE
ANNAPOLIS, IRON COUNTY, MISSOURI

EPA FACILITY ID: MO0000958611

Prepared By:

Missouri Department of Health and Senior Services
Division of Community and Public Health
Bureau of Environmental Epidemiology
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

On September 7, 2006, the Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), completed a Public Health Assessment for the Annapolis Lead Mine at the request of the U.S. Environmental Protection Agency (EPA). In the Public Health Assessment, DHSS recommended additional surface soil testing of residential yards in the town of Annapolis, Missouri.

EPA has completed the surface soil testing of yards in Annapolis and requested that DHSS, in cooperation with ATSDR, complete this health consultation. This health consultation will review and comment on the surface soil data collected from residential yards and driveways as part of the environmental evaluation of Annapolis, Missouri.

Background

Throughout most of its history, the State of Missouri has been the top producer of lead in the country. Deposits of lead ore have been discovered and mined in many of Missouri's counties south of the Missouri River and in many locations these lead deposits occurred at or near the surface. Much of the southeastern and southwestern parts of the state have been mined for lead or related minerals at some time in the past, often leaving behind elevated levels of lead and other mining related contaminants. Over time, these contaminants can move to residential areas due to wind or water erosion or from human activities such as using mine wastes as fill material in yards or driveways. In other instances, residential development has expanded into areas that were previously mined. Studies have shown that residential exposure to mining, milling and smelting wastes around these locations is related to an unacceptably high percentage of children with elevated blood lead levels (1,2). Because of the findings of these studies, DHSS recommends soil sampling of residential properties around these areas.

One such area is located near Annapolis, population 310, in Iron County in southeastern-Missouri, approximately 60 miles west of Cape Girardeau (3). See Figure 1. Lead mining occurred approximately one mile east of the Annapolis city limits starting in 1919 at the Annapolis Lead Mine (ALM) and continued sporadically until stopping around 1940 (4). Beginning in 1919, several companies owned the ALM, mining operations and associated mineral rights (4). Production figures indicated that approximately 1,173,000 tons of mining wastes were generated between 1919 and 1931 (5). Ores were excavated, crushed, concentrated and stored on site prior to offsite shipment for smelting. The crushed, lead-contaminated wastes (tailings) were disposed of in a ravine on the property. The resulting pile of waste was highly erodible, having steep sides and an outwash area that fanned westward towards Sutton Branch Creek.

In 2005 and 2006, EPA completed a time-critical removal action at the ALM site, consolidating and covering waste materials on site to prevent the continuing erosion of lead-contaminated tailings. As a result, the movement of tailings from the site has been greatly reduced. The EPA

and Missouri Department of Natural Resources (MDNR) are promoting vegetation growth covering the ALM site and have placed rocks around the tailings pile to further reduce erosion and also to discourage illicit removal of the tailings. These actions have greatly reduced the chance of contaminants moving from the site.

Further information on ALM and test results can be found in the Public Health Assessment of the Annapolis Lead Mine.

Site Investigations

In January of 2005, EPA began collecting surface soil samples from 85 yards in and around Annapolis, including one school and two churches. Each yard tested was divided up into sections, depending on the size and shape of the yard, and a soil sample from each section was collected and tested separately for lead. These soil samples were tested for lead to determine if yards in Annapolis contain lead-contaminated mine waste. Based on initial screening test results, the average level of lead found in the soils collected from all 85 yards was 142 parts of lead per million parts (ppm) of soil.

Only one yard in Annapolis was found to have lead concentrations above 400 ppm throughout the yard. One driveway at another yard had a lead concentration of 1,180 ppm, but the remainder of the yard had lead concentrations below 400 ppm.

At three additional homes, initial screening tests did reveal concentrations of lead above 400 ppm in one of the sections at each yard. The highest level of lead found in any section of these three yards was 609 ppm of lead. EPA tested these three yards again and found that the average concentration of lead in the entire yard soil was below 400 ppm, with the highest concentrations of lead being nearest the house. The average lead concentrations in these three yards were 277 ppm, 247 ppm, and 201 ppm.

DISCUSSION

Health assessors typically use media-specific comparison values (CVs) developed by ATSDR or EPA to select environmental contaminants of concern. However, ATSDR and EPA have not developed a CV for ingestion of lead through soil. Therefore, the usual approach of estimating human exposure to an environmental contaminant and then comparing this dose to a health guideline, or CV, cannot be used. Instead, exposure to lead is evaluated by using a biological model that predicts a blood lead concentration that would result from exposure to environmental lead contamination. The modeled blood lead concentration is then compared to the level of concern for blood lead concentrations in children as recommended by the Centers for Disease Control and Prevention (CDC) (CDC, 2005). CDC's current level of concern is10 micrograms of lead per deciliter of blood (10 µg/dL). (6) Using this model, EPA has established a standard cleanup value of 400 parts per million (ppm) for lead concentrations in soil of residential yards using the default parameters in this model (7). The default parameters in the model include many estimated values such as the amount of soil ingestion and time spent outdoors. If the default parameters are found to not be accurate in an area being investigated, the cleanup value used at that site may be different.

The pathway of concern for yards in Annapolis is by incidental ingestion (swallowing) of lead-contaminated soil in the yards. This type of ingestion typically occurs when a person, especially a child, transfers lead-contaminated dust or dirt to their mouth from dirty hands, toys, etc. Other potential exposure pathways, such as inhalation (breathing) or dermal contact (touching) are expected to be of less concern.

One yard in Annapolis did have lead concentrations throughout the yard above 400 ppm. Properties adjacent to this yard were tested and were not found to have elevated concentrations of lead. EPA has remediated this yard to prevent exposure to lead by removing the soil in the yard and replacing it.

One driveway at a home in Annapolis contained levels of lead of 1,180 ppm. The contamination in this driveway appears to be localized because other areas of this yard and adjacent yards did not contain elevated levels of lead. EPA has remediated this driveway to prevent exposure and the possibility of contamination migrating from the driveway.

EPA did find some isolated areas in three residential yards with lead concentrations above 400 ppm. Soil samples containing the highest concentrations of lead were located immediately adjacent to the homes, which suggests that the source of this soil contamination may be from lead based paint coming from the house instead of being caused by mining operations. EPA does not have authority to clean up contamination from lead based paint.

Lead from paint is typically more bioavailable than lead in mine waste, which means that this type of lead is more likely to enter the body if an individual comes in contact with it. Individuals should avoid contact with soils from these areas. However, the average concentrations of lead in these yards is more representative of likely exposure, and the average lead concentration for all of these yard were all well below 400 ppm.

EPA's standard cleanup levels for lead in soil only take into consideration minimal exposure assumptions to lead from other sources. However, an individual can be exposed to significant amounts of lead through other sources such as drinking water, lead paint, and other items containing lead including certain toys, jewelry, herbal remedies, Mexican candies, water hoses, and others. Even though the soil in the majority of the yards in Annapolis were not found to be above EPA action levels, over 60 percent of the houses in Annapolis were built before 1970 and over 80 percent were built before 1980 (3). Houses built before 1978 are more likely to contain lead-based paint. Therefore, residents of Annapolis, especially children, could be at risk for exposure to multiple sources of lead.

TOXICOLOGICAL EVALUATION

This section will describe what is known, and what is not known, about environmental exposures to lead. An outline of possible health effects will be presented, and the likelihood of lead causing cancer will be evaluated.

Lead

Lead is a naturally occurring metal found in the earth's crust. It is mined and processed for use in various industries. The practice of depositing lead-contaminated mine tailings above ground has made a large volume of lead more accessible to people. Lead is used in some types of batteries, ammunition, ceramic glazes, medical equipment, scientific equipment, and military equipment. Lead is sometimes found in drinking water, toys, jewelry, herbal remedies, Mexican candies, water hoses, and other items some individuals often eat or mouth.

At one time, lead was used as an additive in gasoline and in paint. Lead from gasoline was released into the air in automotive exhaust and deposited along roadways. Houses built before 1978 may contain lead based paint. Lead in the soils in the inner cities is often attributable to lead based paint and leaded gasoline (8).

Lead has no nutritional benefits for humans. Exposure to lead can occur by inhalation or ingestion. Lead is not readily absorbed through the skin, so dermal contact is not an important route of exposure.

CDC's current level of concern is 10 micrograms of lead per deciliter of blood (10 µg/dL). Studies have shown that there is a definite correlation between concentrations of lead in soils and blood lead levels in children. In general, blood lead levels increase as the lead concentrations in soil and dust increase. As blood lead levels increase, the likelihood of adverse health effects also increases. Examples of adverse health effects of children exposed to lead include learning difficulties and behavioral problems.

While the EPA considers lead to be a probable human carcinogen and the National Toxicity Program (NTP) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens, there have been no studies linking residential ingestion of lead contaminated soil or drinking water with an increase cancer risk (8, 9). Although the American Cancer Society estimates less than half of men and slightly more than a third of women in the United States will develop some form of cancer in their lifetime, the primary health concern from lead in Annapolis is not cancer; instead, the primary concern from exposure to lead in Annapolis is the effects lead has on the nervous system, especially on children less than 72 months of age (10).

Lead has the greatest effect on the nervous system, especially in children. Pregnant women can experience complications with their pregnancy if they are exposed to high levels of lead. These complications can range from low birth weight to miscarriage. Pregnant women can also pass lead to their unborn baby; the health effects of lead on unborn babies are discussed below. (8)

Children's Health

In general, children are more likely than adults to be exposed to contaminants in soil. In their daily activities, children have a tendency for frequent hand-to-mouth contact and often introduce non-food items into their mouths. Because children are smaller and their bodies typically retain

more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

Children are more susceptible to lead poisoning than adults and are more likely to be exposed to lead contaminated materials. Babies and children can swallow and breathe lead in dirt, dust, sand, or paint chips while they play on the floor or ground. Also, compared to adults, a larger proportion of the amount of lead ingested (swallowed) will enter the blood in children (8). While about 99% of the amount of lead swallowed by adult will leave as waste within a few weeks, only about 32% of lead swallowed by a child will leave as waste (8). All of these factors result in children being more affected by lead than adults when they have similar lead concentrations in their environment.

When children are exposed to lead contaminated materials, a variety of adverse health effects can occur depending on the level of lead to which they are exposed and the duration of exposure. These effects include learning disabilities, slowed growth, hyperactivity, impaired hearing, and at very high exposure levels, even brain damage (8). Unborn children can also be exposed to lead through their mothers and are at risk of premature birth, low birth weight, decreased mental ability, learning difficulties, and reduced growth as young children (8).

Blood lead levels of 10 µg/dL are associated with learning difficulties in children. Yearly blood-lead testing of children under 72 months old is key to determining if the child has been exposed to lead. Eliminating exposure pathways by controlling lead-contamination sources, practicing good personal hygiene, and eating a proper diet high in calcium can prevent lead poisoning in children. Blood-lead testing is emphasized for children under 72 months of age because they are most susceptible to blood-lead poisoning.

Children who exhibit pica behaviors may be at an even greater risk of becoming exposed to contaminants in soil than other children. Individuals who exhibit pica behaviors have a craving to put non-food items in their mouth or eat non-food items, such as dirt, paint chips, sand, etc. Children exhibiting pica behavior should be seen by a physician.

CONCLUSIONS

During the investigation, lead was found by EPA above a level of health concern in the one yard with an average lead concentration above 400 ppm, and another one driveway with a lead concentration near 1,200 ppm. Because EPA cleaned up this yard and driveway, these areas are considered a *Public Health Hazard* for past exposures only. A site that is classified as a public health hazard poses a health risk as a result of long-term exposures to hazardous substances. In addition, three more yards were identified by EPA as having a lead concentration above 400 ppm in one section of the yard near the home. This lead is likely from lead based paint, which is more bioavailable than other forms of lead, but these areas will not be cleaned up by EPA. Although the average level of lead in these yards is below 400 ppm, these discrete areas of these yards are considered a *Public Health Hazard* for past, current and future exposures, unless some sort of cleanup action is taken. Individuals, and especially children, should not play, garden or work in these areas of the yard.

Lastly, based on the information from EPA's site investigation, all of the remaining yards and driveways in the Annapolis area are considered *No Apparent Public Health Hazard*. This category is used for sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects. This category is based on the following conclusions:

1. The one home and the one driveway found by EPA to be contaminated with lead above a level of health concern were cleaned up. Furthermore, the contamination from these areas was not found to have migrated to adjacent properties.

2. None of the remaining homes in Annapolis showed average lead concentrations above 400 ppm in residential soil.

RECOMMENDATIONS

1. DHSS recommends education of individuals in and around Annapolis about the hazards and sources of lead and precautions to take to avoid lead poisoning.

2. DHSS recommends blood lead testing for pregnant women and yearly testing of children less than 72 months of age.

3. DHSS recommends that children's play areas not be placed in locations found to have elevated lead concentrations. Instead, placing children's play areas away from contaminated areas may encourage children away from the contaminated areas.

4. DHSS recommends that gardens not be placed in areas found to have elevated lead concentrations. If gardens are placed in areas with elevated lead concentrations, individuals should consider reducing the use of root crops and leafy vegetables and give planting preference to fruiting crops.

5. DHSS recommends homeowners take steps to limit access to lead in soils in the areas of the yards identified by EPA as having lead based paint contamination. Some examples of the many different ways a homeowner may accomplish this are by establishing a vegetative cover over the area; covering the areas with several inches of clean soil, pea gravel or pavement; removing the contaminated soils; or other methods to reduce exposure.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for Annapolis yards contains an explanation of the actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public

health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR, or other stakeholders at the site:

1. DHSS/ATSDR will address community health concerns and questions as they arise.

2. DHSS/ATSDR will provide educational materials and training to individuals in the Annapolis area regarding lead exposure and multiple sources of lead.

CERTIFICATION

The Missouri Department of Health and Senior Services (DHSS) prepared this Annapolis, Iron County, Missouri Health Consultation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation were initiated. The Cooperative Agreement partner completed the editorial review.

Technical Project Officer, CAT, CAPEB, DHAC

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

for A.Y.

Team Lead, CAT, CAPEB, DHAC, ATSDR

REFERENCES

1. Agency for Toxic Substances and Disease Registry. Big River Mine Tailings Superfund Site Lead Exposure Study. Atlanta: US Department of Health and Human Services;1998.

2. Agency for Toxic Substances and Disease Registry. Jasper County Superfund Site Lead and Cadmium Exposure Study. Atlanta: US Department of Health and Human Services;1995.

3. U.S. Census Bureau. Available from: http://factfinder.census.gov/servlet/SAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=annapolis&_cityTown=annapolis&_state=04000US29&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010&show_2003_tab=&redirect=Y

4. Agency for Toxic Substances and Disease Registry. Public Health Assessment for Annapolis Lead Mine. Annapolis, Iron County, Missouri. Atlanta: US Department of Health and Human Services; 2006 Sept. 7.

5. Ecology and Environment, Inc. Superfund Technical Assessment and Response Team. Expanded Site Inspection/Removal Assessment for the Annapolis Lead Mine Site. Annapolis, Missouri. 1999 February 19.

6. Agency for Toxic Substances and Disease Registry. DHAC Guidance for Evaluating Cleanup Levels for Lead in Soil. Atlanta: US Department of Health and Human Services.

7. U.S. Environmental Protection Agency. Superfund Lead-Contaminated Residential Sites Handbook. 2003 August.

8. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead, update. Atlanta: US Department of Health and Human Services; 1999 July.

9. National Toxicology Program. Lead (CAS No. 7439-92-1) and Lead Compounds Substance Profiles. Report on Carcinogens, Eleventh Edition; 2004.

10. American Cancer Society. Cancer facts and figures, 2007. Atlanta: American Cancer Society, Inc.; 2007.

PREPARERS OF THE REPORT

Preparer:

Jeff Wenzel
Environmental Specialist
Bureau of Environmental Epidemiology
Missouri Department of Health and Senior Services

Reviewers:

Cherri Baysinger
Chief, Bureau of Environmental Epidemiology
Missouri Department of Health and Senior Services

Jonathan Garoutte
Environmental Specialist
Missouri Department of Health and Senior Services

Arthur Busch
Environmental Specialist
Missouri Department of Health and Senior Services

ATSDR Technical Project Officer:

CDR Alan Parham
Environmental Health Scientist
Division of Health Assessment and Consultation

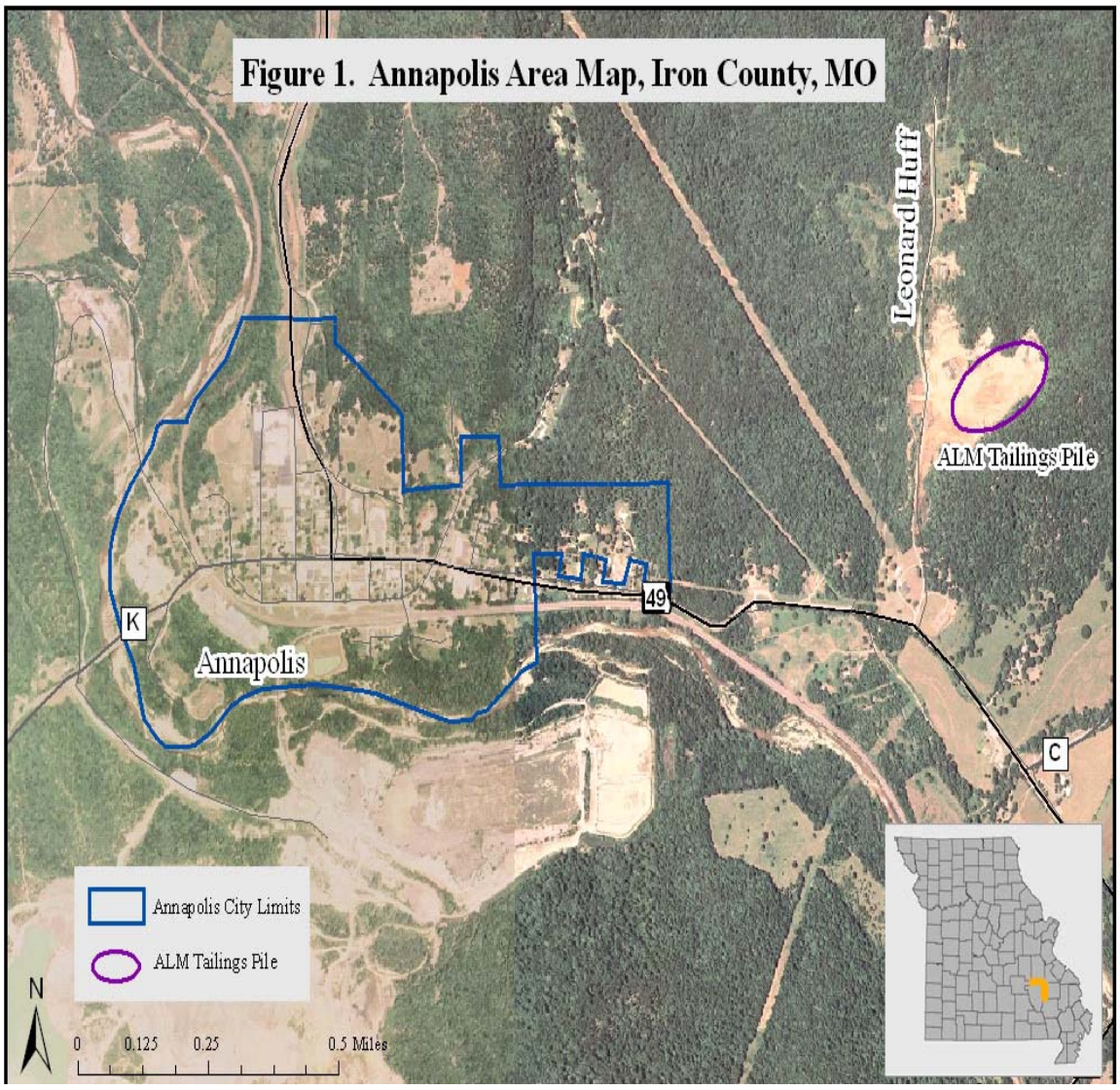
Alan Yarbrough
Team Lead
Environmental Health Scientist
Division of Health Assessment and Consultation

ATSDR Regional Representative:

Denise Jordan-Izaguirre
Senior Regional Representative
EPA Region VII

Attachments:

Figure 1: Annapolis Area Map, Iron County, Missouri



Missouri Department of Health and Senior Services, Division of Community and Public Health, Bureau of Environmental Epidemiology