HEALTH CONSULTATION

FINLAND RADAR STATION

LOOKOUT MOUNTAIN VILLAGE, LAKE COUNTY, MINNESOTA

Prepared by:

Minnesota Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Health Consultation

Finland Radar Station
(Lookout Mountain Village)

Lake County, Minnesota

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Foreword

This document summarizes health concerns associated with the Finland Radar Base, also known as Lookout Mountain Village in Lake County, Minnesota. This facility is owned and operated by Finlandia Development Corporation/Finlandia LLC. This document is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary to do such an evaluation:

- Evaluating exposure: MDH scientists begin a site evaluation by reviewing available information about environmental contamination at the site, or emitted from the site. The first task is to find out how much contamination is present, where it is found, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data; instead MDH relies on information provided by the Minnesota Pollution Control Agency (MPCA), and other government agencies, businesses, and the general public.

- Evaluating health effects: If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health, i.e., the health impact on the community as a whole and is based on existing scientific information.

- Developing recommendations: In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure to contaminants. The role of MDH in dealing with individual sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including MPCA, or local government. However, if an immediate health threat exists, MDH will issue a public health advisory warning of the danger and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the organizations responsible for cleaning up the site, and the community surrounding the site. Any conclusions about the site are shared with these groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. *If you have questions or comments about this report, you are encouraged to contact MDH.*

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Introduction

This health consultation evaluates potential exposures to contaminants found at the Lookout Mountain Village site (formerly the Finland Air Force Radar Base) in Finland, Minnesota. This document examines contaminated media (water, air and soil), transport mechanisms and routes of exposure (ingestion, inhalation and dermal contact) to determine the likelihood of individual exposure to contamination. The site is on the Minnesota Permanent List of Priorities (PLP; State Superfund). The Minnesota Pollution Control Agency (MPCA) requested this health consultation. MPCA project files along with electronic documents provided to the Minnesota Department of Health (MDH) were reviewed. These documents and several site visits by the MPCA and MDH staff from 1997 to 2003 form the basis for this health consultation.

Site Description and History

Lookout Mountain Village is approximately 140 acres of hilltop (formerly known as Finland Air Force Radar Base) on the North Shore of Lake Superior about half way between Duluth and Grand Marais near the town of Finland (Population approximately 450) (see Figures 1, and 2). A height finder and long-range search radar were operated at the base from the mid 1950s –1980. The site was sold to a private party in the early 1980s and has been owned by Finlandia LLC since August 1995. Finlandia owns and operates a wastewater treatment system at the Lookout Mountain Village in Finland, Minnesota. The system is designed to treat approximately 16,200 gallons per day of domestic wastewater and serves 43 single-family homes. Wastewater from 27 of these homes is directed through a 25,000-gallon holding tank and lift station before discharging to a sand filter. Wastewater from the remaining homes is directed by gravity through septic tanks to a sand filter. The MPCA has a Consent Decree with Finlandia LLC regarding the wastewater treatment facility that serves the Lookout Mountain Village (MPCA, 1998). The wastewater treatment plant is currently in compliance. However, numerous chemical and physical hazards are present in many of the buildings on site.

Buildings

The site contains 45 homes and an additional 20 commercial buildings. Many of the commercial buildings are stripped and gutted and appear to be structurally unstable. These buildings present physical and chemical hazards to anyone who enters them. Most of the buildings are not secure, and there are indications of regular trespassing in and around the buildings. Many of the buildings have leaking roofs, and missing doors and windows. It appears that individuals scavenge materials (such as copper wiring, scrap metal, and other building materials) from the buildings. Commercial space on site has been used for various purposes including a church youth group, a fish smoking business (no longer in operation because of code violations), and an appliance-recycling center. Small businesses have left behind trash when they vacate. For example, an appliance-recycling business left behind dozens of appliances (see Figure 3). A portion of Building 306 is filled with articles of clothing. Building 306 is missing windows, and water appears to be infiltrating the room where the garments are stored. The MPCA and MDH have not been given access to the interior of most commercial buildings after repeated attempts. On September 4, 2003, MPCA attempted to enter buildings 208, 108, and 303 but property management said they did not have keys.

Most of the buildings on site are accessible to foot traffic, and entrance is unhindered by lack of doors or windows in many cases. A gate was installed in the summer (2003) to discourage car traffic to the commercial building area. However, there is evidence of regular foot traffic and trespassing in many of the commercial buildings.

a) Residential Units

Nearly all of the 45 homes on the site appeared to be occupied when MDH visited in July 2003. The three homes visited by MDH had floor tiles suspected of containing asbestos. It is likely that the other housing units also contain asbestos tile floors. Asbestos tile floors have also been found in the commercial buildings. Long-term residents who have lived at the Lookout Mountain Village for several years were not notified of possible lead-based paint hazards until the summer of 2003. Most of the housing was built before 1978 when lead based paint was commonly used. MDH tested the new paint in three housing units for lead with a color indicator test kit, and there was no indication of lead in the surface paint. However, the testing was not complete and is not a substitute for a complete lead-based paint survey by a licensed contractor. Furthermore, the housing units have not been surveyed for asbestos containing materials by a licensed inspector. The MPCA has sent certified letters to Finlandia LLC requesting information pertaining to suspected asbestos-containing materials observed in numerous buildings on site in July 2002 and July 2003 (See Appendix A). Appendix B contains the MPCA asbestos inspection reports for September 2003 and December 2003.

Two other issues reported by residents are carbon monoxide and mold. During the spring of 2003, a family was sent to the hospital for carbon monoxide poisoning caused by a faulty furnace. Other residents have complained about mold. The total number and ages of children living on site are not known, but many of the homes have childrens' toys in the yards.

b) Building 203 (Heating Plant)

The Heating Plant room has 3 large boilers wrapped in deteriorated insulation (see glossary for a legal definition) containing suspected asbestos materials that have been pulverized. Note the amount of deterioration in the insulation from April 4, 2002, and June 5, 2003, in Figures 4, 5 and 6. The boilers contain many pounds of friable and pulverized thermal insulation. The boilers, walls, and ceiling contain large areas of deteriorated paint that is likely lead-based (see glossary for legal definitions). MDH staff tested the paint in Building 203 with a lead paint color indicator marker. The surface paint tested positive for lead. There is evidence of wind blowing materials in and out of the boiler room's missing and un-secured doors, making this building a lead source and a likely asbestos exposure hazard.

When the site was an operational radar base, it appears the some of the buildings were heated with hot water that was pumped from building 203 in elevated ducts containing thermal insulation. Figure 7 depicts the elevated ductwork (thermal system insulation). Based on the inspection of the ductwork remnants protruding from building 203, the insulation appears to contain asbestos. What became of the many pounds of suspected asbestos containing materials in the elevated ductwork is not known. It is possible that some of these materials are stock piled somewhere on site.

c) Building 207 (Dining Hall)
Portions of the dining hall ceiling are collapsing from extensive water infiltration. The building contains peeling paints (probable lead based) inside and out. There is a stockpile of suspected asbestos-containing pipe insulation stored in the dining hall that appears to have been scavenged from more than one location. The piping contains approximately 200 linear feet of insulation. (See Figure 8). Because the building is missing windows and doors, winds can stir up debris on the floor and cause snow to collect in drifts inside the building. Property management recently secured some of the dining hall's windows and doors.

d) Building 107 (Transportation)
Building 107 appears be a maintenance garage for heavy machinery. It has 3 large bay doors for receiving large machinery. One of the bay doors appears to be inoperable and remains open. The cement block building is covered with peeling (suspected) lead-based paint. Several of the blocks have fallen off the dilapidated building (see figure 9). There are 3 drums with unknown contents in front of the building, and approximately 45 transformers were stored in the garage bay. Some of the transformers contained PCBs, and the floor is stained with oil leaking from several of the transformers. The building also contains suspected asbestos-containing floor tiles that are crumbling from water infiltration. Other suspect asbestos containing materials include several long runs of water damaged piping insulation found on the heating system. Building 107 is next to partially deconstructed radar domes (see figure 9).

The MPCA sent letters in July 2002 and in July 2003 requesting information regarding asbestos-containing materials and lead based paint in the buildings on site (see Appendix A). In a letter to the MPCA, Finlandia LLC stated they were contacting an asbestos abatement contractor for asbestos abatement in the garage (building 107), but did not mention any other buildings (See Appendix C). The MPCA has advised Finlandia to not demolish any buildings on site without first conducting an asbestos and lead based paint survey. To date, no asbestos or lead based paint surveys have been conducted on site.

MDH documented the storage of 16 electrical transformers in building 107 in April 2, 2002. Subsequent testing of several transformers showed the presence of PCBs. By June 14, 2003, the number of transformers stored in building 107 increased to 46. Many of the transformers left stains on the garage floor (see figure 10). MPCA reported that 36 of the transformers contained PCB concentrations below the regulatory threshold of 50 ppm (considered non-PCB containing), and 10 transformers contained PCBs of 50-499 ppm. According to the MPCA, the 10 transformers containing PCBs greater than 50 ppm were sent to a hazardous waste facility by Cooperative Light and Power staff. Cooperative Light and Power shipped the remaining 36 transformers to B & B Transformers Inc for disposal. According to MPCA, Cooperative Light and Power has agreed to clean the PCB stains on the garage floor. Because the transformers were stored in various locations in the garage, the MPCA has recommended that the whole floor be cleaned. Many of the buildings on site have very old fluorescent light ballast that may contain PCBs.

The PCA collected two paint chips from Building 107; these were analyzed for lead at the MDH laboratory. Both samples tested positive for lead. The samples contained 0.05 -15.0 % lead by weight.

e) Building 303 Multi-Purpose

Building 303 was a multi-purpose building originally used for recreational activities. A smoked fish business most recently occupied building 303. The company sold smoked fish to the public. MDH has documented the dumping of partially burned fish carcasses and piles of trash scattered outside the building (see figure 11). Also located outside the building were abandoned vehicles and a dumpster filled with water-logged fish carcasses. The Minnesota Department of Agriculture cancelled the facility's permit in the summer of 2003. The trash and abandoned vehicles were removed in response to a MPCA warning for violation of solid waste management rules. On December 4, 2003, MDH and the MPCA observed the continued operation of the fish smoking business after the license had been cancelled.

f) Building 112 (Power Plant)

During a site visit on September 4, 2003, the MPCA collected 10 samples in building 112 for asbestos analysis. Table 1 lists the sample materials and their asbestos content. Several of the samples tested positive for chrysotile, and amosite. Asbestos-containing materials in building 112 were significantly deteriorated and friable (see glossary for legal definitions). Building 112 contains pounds of peeling paint that have accumulated on the floor (See Figure 12). The MPCA collected four paint chips in building 112, which MDH analyzed for lead. The paint chips lead content ranged from 0.3 – 1.2 percent by weight.

Table 1 Building 112 Power Plant Asbestos Samples Collected on September 4, 2003					
Sample Type	Sample Location	Layers	Percent of Sample	Fibrous Non-asbestos Content Total or Layer %	Asbestos % Content Total
Bacher board debris on floor	Building 112 main area	2	>99	Cellulose 90 Hair 5	None-detected
			>1	Cellulose 15 Hair 5	Chrysotile 30
Preform debris Along wall	Building 112 main area	1	100	Glass Fibers 2	Chrysotile 5
Preform debris Along wall	Building 112 main area	1	100	Glass Fibers 2	Chrysotile 5
Transite debris on floor	Building 112 main area	2	5	None Detected	None Detected
			95	Glass Fibers 1	None Detected
Transite debris on floor	Building 112 main area	1	100	None Detected	None Detected
12" pipe Magnesium based insulation debris	Building 112 main area	1	100	None Detected	Amosite 15
12" pipe Magnesium based insulation debris	Building 112 main area	1	100	None Detected	Amosite 15
9x9 green floor tile poor condition	Building 112 back entry	2	95	None Detected	Chrysotile 5
			5	None Detected	Chrysotile 10
Aircell from pipe	Building 112 bathroom	1	100	Cellulose 90	Chrysotile 2
Aircell from pipe	Building 112 bathroom	1	100	Cellulose 90	Chrysotile 2

Trash/Solid Waste

It is not uncommon to find scattered trash piles throughout the site consisting of general refuse, appliances, and other solid waste (see Figure 13). There is a history of burning trash at the site as recently as 2002 (MDH 2002). The Minnesota Pollution Control Agency (MPCA) issued a letter of warning to Lookout Mountain Village management (Finlandia LLC/Juno Investments) on June 11, 2003 for violations of Minnesota Solid Waste Rules 7035 (1). Finlandia management paid for the removal of several dozen cubic yards of solid waste and approximately 100 tires from the property in July 2003. Several of the buildings on site are piled with solid waste, and the accumulation and mismanagement of solid waste at the site has been a continuing problem.

Exposure Assessment

Residents in the homes near the Finland Radar site must come into physical contact with the contaminated soils or groundwater in order for the chemicals to have the ability to cause adverse health effects. In order for residents to come into contact with the chemicals of concern there must be a *completed exposure pathway*. A completed exposure pathway consists of five main parts that must be present for chemical exposure to occur. These include: 1) a source of the toxic chemicals of concern; 2) environmental transport, which is a way for the chemical to move from its source to bring it into contact with the residents (soil, air, groundwater, surface water); 3) a point of exposure, which is a place where the residents come into physical contact with the chemical (on-site, off-site); 4) a route of exposure, which is how the residents come into physical contact with the chemical (drinking, eating, touching); and, 5) people who could be exposed, which are people living near the facility who come into physical contact with site-related chemicals.

The Finland Radar site is currently unfenced and provides unrestricted access to area residents. Approximately 45 homes are on the site. Toys seen outside the homes indicate small children are living on the site. Broken glass, graffiti, visible trash, and worn trails indicate that the exposure pathway is complete, and would likely include both adults and adolescents. The physical hazards (structural concerns, broken glass, etc.,) alone are cause for alarm. Particulates (asbestos insulation fibers, peeling paint, etc.) and the soil exposure pathway are of concern for chemical hazards.

Agency for Toxic Substance and Disease Registry (ATSDR) Child Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children make them of special concern to communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to contaminants at hazardous waste sites. A child's behavior and lifestyle will influence exposure. Children can be additionally exposed to environmental contaminants because children play in the dirt, put things in their mouth, and they ingest inappropriate items. Children often bring food into contaminated areas risking cross contamination when they eat items that have fallen to the ground or floor. In general, children ingest more soil than adults. In warm weather, children often spend significant time outdoors with little clothing for protection.A child's exposure to some environmental contaminants such as PCBs can start during their gestational development and continue with the ingestion of contaminated breast milk. The developing body systems of children can sustain permanent damage if exposures occur during critical growth stages. Children drink more fluids, eat more food, and breath more air per kilogram of body weight than adults, resulting in higher doses of chemical exposure per body weight. Children whose families are subsistence fisherman can be additionally exposed to PCBs from locally caught fish. Children who live on the Lookout Mountain Village site can be exposed to asbestos and lead contaminated soil or dust in their houses, private yards, and throughout their neighborhood. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

Chemicals of Concern

Polychlorinated Biphenyls (PCB) Exposure and Toxicity

PCBs are very persistent chemicals. Degradation half-lives for PCBs are typically determined to be 2 to 10 years in soil, and less than 2 months in the air (ATSDR 1998). Higher chlorination of PCBs is associated with greater toxicity, lower vapor pressure (and therefore less evaporation), and slower degradation. The composition of a mixture of PCBs in the environment will, therefore, change, not only because of selective decomposition of PCB congeners but also because of different evaporation rates. Therefore, as an exposed PCB source ages, the ratio of highly chlorinated congeners to congeners with lesser chlorination may increase.

PCBs are lipid (fat) soluble chemicals and are directly absorbable by inhalation, ingestion, and through the skin of animals, including humans. This affinity for lipids and hydrophobic organic molecules allows PCBs to be stored in the fat of animals, including humans, and causes them to bind preferentially to the organic fraction of soil and sediment. The half-life for PCBs in animals is very long (about 7½ years in humans), and accumulation of PCBs can continue over an entire lifetime. Therefore, workers who are exposed to PCBs on the job will retain a large proportion of their overall dose even after the source of exposure has been removed.

The Environmental Protection Agency Integrated Risk Information System (IRIS) lists PCBs as probable human carcinogens based on the results of animal studies (EPA 1997a). Furthermore, PCBs may be associated with adverse effects other than cancer, such as immunological or developmental effects. Studies of workers who worked directly with PCBs suggest that exposure at high concentrations causes irritation of the skin, nose, and lungs, gastrointestinal discomfort, and changes in blood and liver (ATSDR 1998). Other studies suggest that the only harmful effect of occupational exposure to high levels of PCBs is a condition known as chloracne (James et al 1993).

MDH recommends minimizing all exposures to potential carcinogens. In its risk assessment activities, however, MDH uses an exposure that may be expected to add an incremental increase of 1 cancer case in 100,000 individuals exposed for a lifetime as a "negligible risk level." Using this established risk level as a limit, the exposure of individuals to PCBs should be limited to less than 5 nanograms per kilogram of body weight per day (ng/kg/day) (EPA 1997a). Inhalation exposures of volatilized PCBs from similar sources may be slightly less toxic than inhalation exposure to particulate sorbed PCBs, dermal exposure, or ingestion of PCB-contaminated soil or water as described above. It is important to note doses posing negligible health risk for both cancer and non-cancer endpoints are similar.

PCBs can be taken into the body from many sources, and they accumulate in the body over a lifetime. Therefore, the health criterion dose refers to average exposure from all sources over a lifetime. MDH has concerns about people's exposures to PCBs from sources outside the building, most notably from fish. Because of the proximity to the lake, it is assume that people living on the site might eat locally caught-fish. The MDH fish consumption advisory (MDH 2000) has very stringent advice for people eating fish from certain Minnesota lakes and rivers. MDH recommends that women of childbearing age not eat many popular species at all. This is based on studies of developmental effects on the children of women who consumed large amounts of PCB-contaminated fish.

Asbestos Toxicology

Chemical, physical, and biological processes used by the body to remove asbestos fibers play a role in asbestos toxicity. Asbestos is primarily a human health hazard through the inhalation of asbestos fibers in air. Long-term human and animal exposure to asbestos fibers through inhalation is associated with a buildup of scar-like tissue in the lungs known as asbestosis, with lung cancer, and with a cancer of the lining of the thoracic cavity (or pleura) and other internal organs known as mesothelioma. Asbestosis is characterized by a gradual decline in respiratory function, coughing, and breathlessness. Both lung cancer and mesothelioma may be relatively symptom-less until they reach an advanced stage. All three of these above conditions are typically diagnosed through chest X-rays and lung function tests. Evidence of asbestos exposure, in the form of pleural changes (such as a thickening of pleural tissue, or the formation of pleural "plaques") can often be seen on chest X-rays even in the absence of disease. The time between exposure to asbestos and the occurrence of lung disease or cancer is long, usually between ten and 40 years (ATSDR 1999).

The mechanisms by which asbestos fibers cause disease are not clearly understood, but include the generation of reactive oxygen species on fiber surfaces, the production of growth factors by the body in response to injury caused by asbestos fibers, or direct injury to cells in the respiratory tract (Brody 1993; Voytek et al. 1990, ATSDR 1999). Human epidemiological studies have established a cause and effect relationship between asbestos exposure, and lung disease and cancer in workers. Environmental exposure to asbestos has also been found to be associated with higher rates of mesothelioma, and in some cases lung cancer in several areas of the world where asbestos fibers are exposed at the ground surface (ATSDR 1999, Luce et al. 2000). For lung cancer, the magnitude of the risk appears to be a complex function of a number of parameters, the most important of which are: (1) the level and the duration of exposure; (2) the time since exposure occurred; (3) the age at which exposure occurred; (4) the tobacco-smoking history of the exposed person; and (5) the type and size distribution of the asbestos fibers (ATSDR, 199). Skin contact with asbestos fibers is not believed to pose a health risk, but may result in a localized reaction.

Exposure to asbestos and cigarette smoke together result in substantially greater risk of lung disease and lung cancer (ATSDR 1999). Lung cancer mortality in smokers exposed to asbestos may be ten times higher than the risk to non-smokers exposed to asbestos, and fifty times that of people not exposed to asbestos who never smoked. Several mechanisms may contribute to this multiplicative increase in risk, including a reduction in fiber removal efficiency in smokers, and the adsorption by asbestos fibers of cancer-causing chemicals found in cigarette smoke (ASTDR 1999).

The various mineral types (such as chrysotile, amosite, etc.) are also important in the toxicity of asbestos, especially with regards to the induction of mesothelioma. Amphibole asbestos (the mineral type which includes amosite) is thought to be more potent than chrysotile for the induction of mesothelioma. There appears to be less of a difference in relative potencies between asbestos mineral types for the induction of lung cancer (Berman et al. 1995). The generally lower potency of chrysotile might be because it is more easily broken down into shorter fiber lengths than amphibole and removed by the body due, in part, to its chemical composition. Some studies suggest that over extended periods of exposure to chrysotile asbestos, a "steady state" may be reached where removal mechanisms equal the deposition of new asbestos fibers in the lung. This is not the case for amphibole asbestos, however, where studies indicate that due to its increased resistance to the body's metabolic processes, the total amount of amphibole asbestos in the lung increases continually with exposure, and no "steady state" is reached (Berman and Crump 1999).

Asbestos Exposure Pathways

There are a number of exposure pathways through which people may have been exposed to suspected asbestos containing particulates at the Lookout Mountain site. The exposure pathway of greatest concern for asbestos is inhalation exposure. Workers or trespassers at the site can be exposed when dusts are generated in windy conditions or when individuals scavenge materials, remodel, or alter site conditions in the commercial buildings. Additionally, ingestion and inhalation of suspected asbestos containing materials in residential properties on site is also a concern. Note that most of the buildings on site have not been surveyed for asbestos-containing materials.

There are other past and present exposure pathways of concern for residents in the community surrounding the site. The pathways, listed in approximate order of concern include:

- Potential inhalation of asbestos fibers released during disturbances of current site conditions
- Potential inhalation of asbestos fibers tracked into rentals by individuals who have entered contaminated areas.
- Potential inhalation of asbestos fibers entrained with particulate emissions from the open pit burning of solid waste materials.
- Potential ingestion of asbestos contaminated soil
- Potential inhalation of asbestos contaminated indoor dust.

Children playing in asbestos-contaminated buildings or in contaminated soil can be exposed. Exposures will vary based on many factors such as hand mouth activity, amount of disturbance, and contact frequency with contaminated materials.

Open pit burning of asbestos contaminated materials can create particulate emissions that may infiltrate nearby structures through open windows and doors. Asbestos-containing dusts may also be tracked into homes or businesses from other site locations where contamination is present. Household dust may thus serve as a continuing source of asbestos contamination in indoor air.

The potential for ingestion of asbestos particulate on fruits, herbs, or vegetables grown in contaminated soils is minimal if the produce is washed.

Lead Exposure and Toxicology

People are typically exposed to lead through a variety of media including air, water, food, dust and soil. Lead is persistent and can accumulate at the soil surface. The potential for lead exposure from soil is influenced by several site-specific factors, including the type of land use (i.e. play area, garden), frequency and duration of contact, and the lead concentration. In addition, the degree of vegetated cover in an area may be a factor because people are more likely to be exposed to lead in bare soil where direct contact is possible. Vegetated areas may also be a concern if the soil becomes uncovered or disrupted (e.g., digging or tilling).

Examples of other potential sources of lead include lead-based paint chips found in older structures, automobile emissions, past automobile wrecking/salvage operations, and open pit burning of solid waste. Regardless of the source of lead, there is potential for human health impacts in areas where exposure to lead contamination is regular or where lead concentrations are elevated. Children playing in lead contaminated buildings or in contaminated soil can be exposed. Exposures will vary based on many factors such as hand mouth activity, amount of disturbance, and contact frequency with contaminated materials.

Past and present exposure pathways of concern for residents in the community surrounding the site include:

- Potential ingestion of lead-contaminated dust or soil as well as paint chips in old buildings
- Potential inhalation or ingestion of lead-containing dust released during disturbances of site conditions

- Potential ingestion or inhalation of lead particulate tracked into rentals by those who have entered contaminated areas.
- Potential inhalation of lead-containing particulate emissions from the open pit burning of solid waste materials.
- Potential infiltration of lead-containing airborne dusts or particulates into homes or businesses.

Ongoing toxicological research indicates that low levels of lead exposure can cause adverse effects, although these effects may not be readily apparent or discernable (ATSDR 1992). Lead has been shown to affect nearly all organs or systems in the human body with the most sensitive being the nervous, blood forming, and cardiovascular systems. Effects include inhibition of heme synthesis and erythropoiesis, neurobehavioral toxicity, and cardiovascular toxicity. Lead has also been shown to cause reproductive and developmental effects, such as premature births, low-weight babies, and decreased mental ability in the infant.

Infants and young children have been demonstrated to be particularly vulnerable to lead exposure. This is based on a combination of several factors including:

- Intrinsic sensitivity of developing organ systems to lead,
- Behavioral characteristics that increase contact with lead from dust and soil (e.g., mouthing and pica behavior),
- Physiologic factors resulting in greater deposition of airborne lead in the respiratory tract and greater absorption efficiency from the gastrointestinal tract in children than in adults
- Transplacental transfer of lead that establishes a lead burden in the fetus, increasing the risk associated with additional exposure during infancy and childhood.

As a result of these factors related to increased susceptibility, health-based guidelines and risk estimates in soil are usually established for young children (1 to 6 years).

The Centers for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) considers blood lead levels greater than 10 micrograms/ deciliter (μg/dL) to be elevated (ATSDR 1992). However, there is no established safe level for blood lead. Acceptable levels of lead in the environment and blood have been lowered in recent years because research indicates that adverse health effects can occur at low lead levels.

State of Minnesota Lead Standards
The State of Minnesota has established the following lead standards:
4761.1100 STANDARDS FOR LEAD IN PAINT, DUST, BARE SOIL, AND DRINKING WATER.

Subpart 1. **Paint.** Paint is lead-based if the paint:

A. contains lead in a concentration of at least one-half of one percent (5,000 parts per million) or more by dry weight as measured by atomic absorption spectrophotometry or by quantitative chemical analysis; or

B. registers at least one milligram of lead per square centimeter or more as measured by an x-ray fluorescence analyzer, unless atomic absorption spectrophotometry or quantitative chemical analysis shows that the lead content is less than one-half of one percent by dry weight.

Subp. 2. **Dust.** Dust is lead-contaminated if atomic absorption spectrophotometry or quantitative chemical analysis determines that the dust contains at least:

A. 50 micrograms of lead per square foot on an interior hard-surfaced floor or carpet;
B. 250 micrograms of lead per square foot on a window sill; or
C. 800 micrograms of lead per square foot on a window well.

Subp. 3. **Bare soil.** Bare soil on residential property or on a playground is lead-contaminated if it contains lead in a concentration of at least 1/100 of one percent (100 parts per million) by weight.

MDH noted many commercial buildings on site may contain lead levels in excess of 100 parts per million (ppm) due to the extensive use of suspected lead based paint. Access to most of the site is unrestricted and several footpaths are present in and around the commercial buildings.

Conclusions

- Many of the site buildings are not secured and pose a public health hazard due to the presence of chemical and physical hazards. Because of the evidence of trespassing, exposure is assumed to be occurring.

- Many buildings on site have not been characterized for lead-based paints, PCB-containing light ballasts, asbestos, and other chemical and physical hazards

Recommendations

- Restrict access to contaminated buildings.
- Conduct asbestos and lead surveys for all buildings and residential housing.
- Secure all windows and doors in contaminated buildings.
- Post signs on buildings with confirmed asbestos materials and deteriorated lead-based paint. These signs should state that the buildings contain asbestos and lead hazards (see Figure 14).
- Immediately secure Buildings 112, and 203.
- First perform a survey for asbestos and lead-based paint before beginning any building demolition.
- Identify and remove all PCB containing light ballasts at this site.
- Wash the PCB stained floor in building 107 according 40 CFR 761.123 (see glossary).
- Provide both MDH and MPCA with copies of the lead-based paint and asbestos surveys conducted on this site.

Public Health Action Plan

MDH will continue to work with the MPCA in addressing community concerns, assisting site investigations, and mitigating exposures through community education. MDH/ATSDR are available for reviewing any site sampling plans, and sample data results in order to address environmental health concerns at the site. MDH will distribute this health consultation, and/or an information sheet summarizing the information in this health consultation to area residents, will continue consultation activities with MPCA and other agency staff on investigations, monitoring and response action activities, and participate in any public outreach events.

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