# Health Consultation

WESTERN MINERALS PRODUCTS

OMAHA, DOUGLAS COUNTY, NEBRASKA

EPA FACILITY ID: NEN000703777

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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

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Superfund Site and Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

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## Foreword: ATSDR's National Asbestos Exposure Review

Vermiculite was mined and processed in Libby, Montana, from the early 1920s until 1990. We now know that this vermiculite, which was shipped to many locations around the U.S. for processing, contained asbestos.

The National Asbestos Exposure Review (NAER) is a project of the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is working with other federal, state, and local environmental and public health agencies to evaluate public health impacts at sites that processed Libby vermiculite.

The evaluations focus on the processing sites and on human health effects that might be associated with possible past or current exposures. They do not consider commercial or consumer use of the products of these facilities.

The sites that processed Libby vermiculite will be evaluated by (1) identifying ways people could have been exposed to asbestos in the past and ways that people could be exposed now and (2) determining whether the exposures represent a public health hazard. ATSDR will use the information gained from the site-specific investigations to recommend further public health actions as needed. Site evaluations are progressing in two phases:

Phase 1: ATSDR has selected 28 sites for the first phase of reviews on the basis of the following criteria:

- The U.S. Environmental Protection Agency (EPA) mandated further action at the site based upon contamination in place

- or -

- The site was an exfoliation facility that processed more than 100,000 tons of vermiculite ore from Libby mine. Exfoliation, a processing method in which ore is heated and "popped," is expected to have released more asbestos than other processing methods.

The following document is one of the site-specific health consultations ATSDR and its state health partners are developing for each of the 28 Phase 1 sites. A future report will summarize findings at the Phase 1sites and include recommendations for evaluating the more than 200 remaining sites nationwide that received Libby vermiculite.

Phase 2: ATSDR will continue to evaluate former Libby vermiculite processing sites in accordance with the findings and recommendations contained in the summary report. ATSDR will also identify further actions as necessary to protect public health.

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## Background

The Western Mineral Products site in Omaha Nebraska, is a former exfoliation facility. The site is located in the downtown area at 3520 I Street. Figure 1 shows the site location. The immediate surroundings of the site are mainly commercial and industrial, with the nearest residences located about ¼ of a mile away. The main floor of the former processing building is currently occupied by a gutter company, and the basement of the building is rented out to an archery club. A meat packing company is located across the street from the former exfoliation facility.

It is not known when the facility was originally constructed. Sometime in the 1940s, the facility began processing vermiculite that was obtained primarily from the vermiculite mine located in Libby, Montana. The facility expanded, or exfoliated, the vermiculite ore to produce a lightweight substance used in insulation materials and other products. This site and the Libby mine were purchased by the W.R. Grace Company in 1967. The facility continued to process vermiculite until 1989. In 1991, Grace cleaned the building, tested it for asbestos, and sold the building and land to the current owner.

The site was one of the highest volume vermiculite processors in the nation. Between 1967 and 1991, records indicate that the plant processed more than 165,000 total tons of vermiculite ore. Over time, it became known that the vermiculite mined from Libby was contaminated with naturally occurring asbestos fibers. Vermiculite from Libby was found to contain several types of asbestos fibers including the amphibole asbestos varieties tremolite and actinolite and the related fibrous asbestiform minerals winchite, richterite, and ferro-edenite [1]. In this report we will use the term **Libby asbestos** to refer to the characteristic composition of asbestos contaminating the Libby vermiculite. It is difficult to measure all the different mineral fibers in Libby asbestos specifically. In this document, soil sample results reported as “tremolite-actinolite” asbestos indicate the presence of Libby asbestos.

Scientific studies throughout the 1980s and information that received media attention in 1999 indicated that Libby mine workers had high rates of asbestos-related respiratory diseases [2–6]. This site is being investigated further because of the large volume of Libby vermiculite ore processed here and because the process used here—exfoliation—can release more asbestos fibers than other types of processing [7].

In April 2000, the US Environmental Protection Agency (EPA) conducted a site visit and observed vermiculite ore and the expanded product in an open area on the north side of the site. In October 2000, EPA collected surface soil samples at the site [8]. Microscopic analysis of the samples showed tremolite-actinolite asbestos at trace levels (less than 1%). This is below EPA Region 7’s current action level for removal action of greater than 1% asbestos.

### Vermiculite Processing

Vermiculite is a non-fibrous, platy mineral similar in form to mica and used in many commercial and consumer applications. Raw vermiculite ore is used in gypsum wallboard, cinder blocks, and many other products; exfoliated vermiculite is used as loose fill insulation, as a fertilizer carrier, and as an aggregate for concrete. Exfoliated vermiculite is formed by heating the ore to approximately 2,000 degrees Fahrenheit ($^oF$), which explosively vaporizes the water in the mineral structure and causes the vermiculite to expand by a factor of 10 to 15 [9]. This site produced expanded vermiculite.

Detailed process information was not available for the site. Vermiculite ore was apparently delivered to the facility on a railroad spur leading to the back of the processing building where exfoliation took place. Workers may have used shovels or mechanical equipment to unload ore from the railcars to the furnace. No documentation was found describing how the stoner rock (waste material) exiting the furnace was stored, but Grace records indicate that the majority of the waste was taken to Southwest Landfill in Omaha, and a smaller percentage of waste went to the Douglas County Landfill in Omaha [10]. Stoner rock from other exfoliation facilities has been shown to contain percentage levels of Libby asbestos (personal communication, James Kelly, Minnesota Department of Health, August 12, 2002).

ATSDR and its partners in the National Asbestos Exposure Review have learned other information about past processing methods that could apply to this site. Before ore and waste handling was automated, workers at many vermiculite processing sites used shovels or forklifts to handle ore. Some vermiculite processing facilities in the United States allowed or encouraged workers and nearby community members to take stoner rock, vermiculite ore, or other process materials for personal use [11]. No records were found indicating whether this was a common practice at the Omaha site. On the basis of Grace records, disposal transporters were contracted to remove waste five times a week, reducing the likelihood that large piles of waste were present on site [10].

Former workers at similar facilities described the exfoliation process as dusty to very dusty at times [12]. By the 1970s, similar plants had installed baghouses to capture dust from some plant operations, but no record of dust control measures at the Omaha Western Mineral Products plant was found. After being cited and fined in 1976 for failure to have a respirator program, the facility implemented a program mandating use of respirators by workers [10]. In the same year, employee monitoring showed that at least five workers had been exposed to tremolite fibers at levels above the time-weighted average mandated by the Occupational Safety and Health Administration (OSHA) [10]. No reports of community complaints about dust from the facility were found.

The Omaha plant ceased operations in 1989. In 1991, the facility was sold. Before the sale, the facility was cleaned, and an industrial hygiene survey was performed. Five post-cleanup air samples collected in former processing areas of the building and analyzed with phase contrast microscopy all contained no visible fibers [10]. Although documentation was lacking, the post-cleanup samples are thought to have been collected under ambient conditions that is, with no active disturbance of dust to simulate activities that may occur during exposure). According to the owner of the company that took over the facility, the building was very clean when they moved in.

**Soil Contamination at the Western Mineral Products Plant in Omaha**

Contaminated vermiculite flakes were observed along the railroad spur leading to the former exfoliation building. In October 2000, EPA representatives collected five surface soil samples at the site. The soil samples were analyzed by polarized light microscopy and transmission electron microscopy for asbestos, with tremolite-actinolite asbestos indicating the presence of Libby asbestos. Results indicated that four of the samples had trace levels of tremolite-actinolite asbestos [8].

**Site Visit**

ATSDR staff members visited the site in September of 2002. Site access was granted by the current facility owner. The group conducted a walk-through of the former exfoliation facility (now occupied by a gutter company and an archery club), the area immediately adjacent to the facility, and the surrounding neighborhood. They also drove around the neighborhood to determine the distances between the site and residences in the area. The following observations were made:

- The former rail spurs are located at the back of the building. This area does not appear to have much activity. The area is partially paved and the remaining areas are overgrown with weeds with no obvious evidence of frequent use. The current building owner stated that he would like to pave the area for future use.
- Several site features that related to the former exfoliation activities were observed. These included a railroad spur along the side of the building, the footprint of two former silos on an exterior concrete pad, and an adjacent building structure with a raised roof and equipment pad footprint (probably the location of the furnace used for exfoliation).
- Some small flakes of vermiculite were observed in the soil and on the concrete pad.
- The surrounding area is mostly industrial and commercial. The nearest residences were about ¼ mile northwest and southeast of the facility.

**Asbestos Overview**

Asbestos is a general name applied to a group of silicate minerals consisting of thin, separable fibers in a parallel arrangement. Asbestos minerals fall into two groups, serpentine and amphibole. Serpentine asbestos has relatively long and flexible crystalline fibers; this class includes chrysotile, the predominant type of asbestos used commercially. Amphibole asbestos minerals are brittle and have a rod- or needle-like shape. Amphibole minerals regulated as asbestos by OSHA include five classes: fibrous tremolite, actinolite, anthophyllite, crocidolite, and amosite. However, other amphibole minerals, including winchite, richterite, and others, can exhibit fibrous asbestiform properties [13].

Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate and are resistant to heat, fire, and chemical and biological degradation.

The vermiculite mined at Libby contains amphibole asbestos, with a characteristic composition that includes tremolite, actinolite, richterite, and winchite; this material is referred to as Libby asbestos. The raw ore was estimated to contain up to 26% Libby asbestos [14]. For most of the mine's operation, Libby asbestos was considered a by-product of little value and was not used commercially. The mined vermiculite ore was processed to remove unwanted materials and sorted into various grades or sizes. The ore was then shipped to sites across the nation for expansion (exfoliation) or use as a raw material in manufactured products. Samples of the various grades of unexpanded vermiculite shipped from the Libby mine contained 0.3%–7% fibrous tremolite-actinolite (by mass) [14].

The following sections provide an overview of several concepts relevant to the evaluation of asbestos exposure, including analytical techniques, toxicity and health effects, and the current regulations concerning asbestos in the environment. A more detailed discussion of these topics will also be provided in ATSDR's upcoming summary report for the national review of vermiculite sites.

***Methods for Measuring Asbestos Content***

A number of different analytical methods are used to evaluate asbestos content in air, soil, and other bulk materials. Each method varies in its ability to measure fiber characteristics such as length, width, and mineral type. For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers longer than 5 micrometer (µm) and with an aspect ratio (length:width) greater than 3:1. This is the standard method by which regulatory limits were developed. Disadvantages of this method include the inability to detect fibers thinner than 0.25 µm in diameter and the inability to distinguish between asbestos and non-asbestos fibers [13].

Asbestos content in soil and bulk material samples is commonly determined using polarized light microscopy (PLM), a method which uses polarized light to compare refractive indices of minerals and can distinguish between asbestos and non-asbestos fibers and between different types of asbestos. The PLM method can detect fibers with lengths greater than approximately 1 µm, widths greater than approximately 0.25 µm, and aspect ratios (length to width ratios) of greater than 3. Detection limits for PLM methods are typically 0.25%–1% asbestos.

Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods that can detect smaller fibers than light microscopic techniques. TEM allows the use of electron diffraction and energy-dispersive x-ray methods, which give information on crystal structure and elemental composition, respectively. This information can be used to determine the elemental composition of the visualized fibers. SEM does not allow measurement of electron diffraction patterns. One disadvantage of electron microscopic methods is that determining asbestos concentration in soil and other bulk materials is difficult [13].

For risk assessment purposes, TEM measurements are sometimes multiplied by conversion factors to give PCM equivalent fiber concentrations. The correlation between PCM fiber counts and TEM mass measurements is very poor. A conversion between TEM mass and PCM fiber count of 30 micrograms per cubic meter per fiber per cubic centimeter ($\mu g/m^3$)/(f/cc) was adopted as a conversion factor, but this value is highly uncertain because it represents an average of conversions ranging from 5 to 150 ($\mu g/m^3$)/(f/cc) [15]. The correlation between PCM fiber counts and TEM fiber counts is also very uncertain, and no generally applicable conversion factor exists for these two measurements [15]. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular air sample.

EPA is currently working with several contract laboratories and other organizations to develop, refine, and test a number of methods for screening bulk soil samples. The methods under investigation include PLM, infrared, and SEM (personal communication, Jim Christiansen, US Environmental Protection Agency, November 2002).

***Asbestos Health Effects and Toxicity***

Breathing any type of asbestos increases the risk of the following health effects.

> *Malignant mesothelioma* – Cancer of the lining of the lung (pleura) and other internal organs. This cancer can spread to tissues surrounding the lungs or other organs. The vast majority of mesothelioma cases are attributable to asbestos exposure [13].
>
> *Lung cancer* – Cancer of the lung tissue, also known as bronchogenic carcinoma. The exact mechanism relating asbestos exposure with lung cancer is not completely understood. The combination of tobacco smoking and asbestos exposure greatly increases the risk of developing lung cancer [13].
>
> *Noncancer effects* – These include *asbestosis*, scarring and reduced lung function caused by asbestos fibers lodged in the lung; *pleural plaques*, localized or diffuse areas of thickening of the pleura (lining of the lung); *pleural thickening*, extensive thickening of the pleura which may restrict breathing; *pleural calcification*, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and *pleural effusions*, fluid buildup in the pleural space between the lungs and the chest cavity [13].

Not enough evidence is available to determine whether inhalation of asbestos increases the risk of cancer at sites other than the lungs, pleura, and abdominal cavity [13].

Ingestion of asbestos causes little or no risk of noncancer effects. However, there is some evidence that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors [13].

ATSDR considers the inhalation route of exposure to be the most significant in the current evaluation of sites that received Libby vermiculite. Actions taken to limit inhalation exposures will also minimize risk from dermal and oral exposures.

The scientific community generally accepts the correlations of asbestos toxicity with fiber length as well as fiber mineralogy. Fiber length may play an important role in how fibers are cleared from the lung, and mineralogy may affect both biopersistence and surface chemistry.

ATSDR, responding to concerns about asbestos fiber toxicity from the World Trade Center disaster, held an expert panel meeting in December 2002 to review fiber size and its role in fiber toxicity [16]. The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths less than 5 μm are essentially non-toxic in terms of association with mesothelioma or lung cancer promotion. However, fibers less than 5 μm in length may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to fully evaluate this possibility.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly because physical differences allow chrysotile to break down and to be cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue [17]. Some researchers believe the resulting increased duration of exposure to amphibole asbestos significantly increases the risk of mesothelioma and, to a lesser extent, asbestosis and lung cancer [17]. However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, as both types increase the risk of disease [18]. EPA's Integrated Risk Information System assessment of asbestos also treats different mineralogies and fiber lengths as equipotent [15].

Evidence suggesting that the different types of asbestos fibers vary in carcinogenic potency and site specificity is limited by the lack of information on fiber exposure by mineral type. Other data indicate that differences in fiber size distribution and other process differences can contribute at least as much to the observed variation in risk [19].

Counting fibers using regulatory definitions does not adequately describe risk of health effects. Fiber size, shape, and composition contribute collectively to risks in ways that are still being elucidated. For example, shorter fibers appear to deposit preferentially in the deep lung, but longer fibers may disproportionately increase the risk of mesothelioma [13,19]. Some of the unregulated amphibole minerals, such as the winchite present in Libby asbestos, can exhibit asbestiform characteristics and contribute to risk. Fiber diameters greater than 2–5 μm are considered above the upper limit of respirability (that is, too large to penetrate deeply into the lungs) and thus do not contribute significantly to risk [13,19]. Methods being developed to assess the risks posed by varying types of asbestos are currently awaiting peer review [19].

***Current Standards, Regulations, and Recommendations for Asbestos***

In industrial applications, asbestos-containing materials are defined as any material with greater than 1% bulk concentration of asbestos [20]. It is important to note that 1% is not a health-based level, but instead represents the practical detection limit in the 1970s when OSHA regulations were created. Studies have shown that disturbing soil containing less than 1% amphibole asbestos can suspend fibers at levels of health concern [21].

Friable asbestos (asbestos which is crumbly and can be broken down to suspendable fibers) is listed as a Hazardous Air Pollutant on EPA's Toxic Release Inventory [22]. This classification requires companies that release friable asbestos at concentrations greater than 0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to-Know Act.

OSHA's permissible exposure limit (PEL) is 0.1 f/cc for asbestos fibers with lengths greater than 5 μm and with an aspect ratio (length:width) greater than 3:1, as determined by PCM [18]. This value represents a time-weighted average (TWA) exposure level based on 8 hours a day for a 40-hour work week. In addition, OSHA has defined an "excursion limit," which stipulates that no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes

[18]. Historically, the OSHA PEL has steadily decreased from an initial standard of 12 f/cc established in 1971. The PEL levels before 1983 were determined on the basis of empirical worker health observations, while the levels set from 1983 forward employed some form of quantitative risk assessment. ATSDR has used the current OSHA PEL of 0.1 f/cc as a reference point for evaluating asbestos inhalation exposure for past workers. ATSDR does not, however, support using the PEL for evaluating community member exposure, as the PEL is based on an unacceptable health risk level.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in buildings in the area, the Department of Health and Human Services, EPA, and the Department of Labor formed the Environmental Assessment Working Group. This work group was made up of ATSDR, EPA, CDC's National Center for Environmental Health, the National Institute for Occupational Safety and Health (NIOSH), the New York City Department of Health and Mental Hygiene, the New York State Department of Health, OSHA, and other state, local, and private entities. The work group set a re-occupation level of 0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure at this level [23].

NIOSH set a recommended exposure limit of 0.1 f/cc for asbestos fibers longer than 5 μm. This limit is a TWA for up to a 10-hour workday in a 40-hour work week [24]. The American Conference of Government Industrial Hygienists (ACGIH) has also adopted a TWA of 0.1 f/cc as its threshold limit value [25].

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7,000,000 fibers longer than 10 μm per liter of water, on the basis of an increased risk of developing benign intestinal polyps [26]. Many states use the same value as a human health water quality standard for surface water and groundwater.

Asbestos is a known human carcinogen. Historically, EPA has calculated an inhalation unit risk for cancer (*cancer slope factor*) of 0.23 per f/cc of asbestos [15]. This value estimates additive risk of lung cancer and mesothelioma using a relative risk model for lung cancer and an absolute risk model for mesothelioma.

This quantitative risk model has significant limitations. First, the unit risks were based on measurements with phase contrast microscopy and therefore cannot be applied directly to measurements made with other analytical techniques. Second, the unit risk should not be used if the air concentration exceeds 0.04 f/cc because above this concentration the slope factor might differ from that stated [15]. Perhaps the most significant limitation is that the model does not consider mineralogy, fiber size distribution, or other physical aspects of asbestos toxicity. EPA is in the process of updating their asbestos quantitative risk methodology given the limitations of the current assessment and the knowledge gained since it was implemented in 1986.

## Discussion

The vermiculite processed at this site originated from the mine in Libby, Montana known to be contaminated with asbestos. Studies conducted in the Libby community indicate health impacts that are associated with asbestos exposure [27,28]. The findings at Libby provided the impetus for investigating this site, as well as other sites across the nation that received asbestos-contaminated vermiculite from the Libby mine. It is important to recognize, however, that the asbestos exposures documented in the Libby community are in many ways unique and will not collectively be present at other sites that processed or handled Libby vermiculite. The site investigation at the Western Mineral Products plant in Omaha is part of a national effort to identify and evaluate potential asbestos exposures at these other sites.

**Exposure Assessment and Toxicological Evaluation**

Evaluating the health effects of exposure to Libby asbestos requires extensive knowledge of both exposure pathways and toxicity data. The toxicological information currently available is limited and therefore prevents definitive determination of the health effects potentially associated with different sizes and types of asbestos. Site-specific exposure pathway information is also limited or unavailable.

- There is limited information on past concentrations of Libby asbestos in air in and around the plant. Also, as described in the preceding section, significant uncertainties and conflicts in the methods used to analyze asbestos exist. This makes it hard to estimate the levels of Libby asbestos people may have been exposed to.
- Because most exposures happened so long ago, not enough information is known about how and how often people came in contact with the Libby asbestos from the plant. This information is needed to estimate exposure doses accurately.
- There is not enough information available about how some vermiculite materials, such as waste rock, were handled or disposed of. This makes it difficult to identify and assess potential current exposures.

Given these difficulties, the public health implications of past operations at this site can only be evaluated qualitatively. The following sections describe the various types of evidence we used to evaluate exposure pathways and reach conclusions about the site.

**Exposure Pathway Analysis**

An exposure pathway is the way in which an individual is exposed to contaminants originating from a contamination source. Every exposure pathway consists of the following five elements: (1) a *source* of contamination; (2) a *media* such as air or soil through which the contaminant is transported; (3) a *point of exposure* where people can contact the contaminant; (4) a *route of exposure* by which the contaminant enters or contacts the body; and (5) a *receptor population*. A pathway is considered **complete** if all five elements are present and connected. A pathway is considered **potentially complete** if it is currently missing one or more of the pathway elements, but the elements(s) could easily be present at some point in time. An **incomplete** pathway is missing one or more of the pathway elements and it is likely that the elements were never present and not likely to be present at a later point in time. An **eliminated** pathway was a potential or completed pathway in the past, but has had one or more of the pathway elements removed to prevent present and future exposures.

After reviewing information from Libby, Montana, and from facilities that processed vermiculite ore from Libby, the National Asbestos Exposure Review team has identified possible likely exposure pathways for vermiculite processing facilities. All pathways have a common source—vermiculite from Libby contaminated with Libby asbestos—and a common route of exposure—inhalation. Although asbestos ingestion and dermal exposure pathways could exist, health risks from these pathways are minor in comparison to those resulting from inhalation exposure to asbestos and will not be evaluated.

The pathways that will be considered for each site are listed in the following table. More detail on the pathways is included in Appendix A. Not every pathway identified will be an important source of exposure for a particular site. An evaluation of the pathways for this site is presented in the following paragraphs.

**Table 1. Summary of Inhalation Pathways Considered for Western Mineral Products in Omaha**

| Pathway Name | Exposure Scenario(s) | Past Pathway Status | Present Pathway Status | Future Pathway Status |
|---|---|---|---|---|
| Occupational | Former workers exposed to airborne Libby asbestos during handling and processing of contaminated vermiculite | Complete | Not applicable | Not applicable |
| | Current workers exposed to airborne Libby asbestos from residual contamination inside former processing buildings | Not applicable | Potential | Potential |
| Household Contact | Household contacts exposed to airborne Libby asbestos brought home on workers' clothing | Complete | Potential | Potential |
| Waste Piles | Community members (particularly children) playing in or otherwise disturbing onsite piles of contaminated vermiculite or waste rock | Potential | Eliminated | Eliminated |
| Ambient Air | Community members or nearby workers exposed to airborne fibers from plant emissions during handling and processing of contaminated vermiculite | Potential | Eliminated | Eliminated |
| Residential Outdoor | Community members using contaminated vermiculite or waste material at home (for gardening, paving driveways, fill material) | Potential | Potential | Potential |
| Residential Indoor | Community members disturbing household dust containing Libby asbestos fibers from plant emissions, or residential outdoor waste | Potential | Potential | Potential |
| On-site Soil | Current onsite workers, contractors, or community members disturbing contaminated onsite soils (residual contamination, buried waste) | Not applicable | Potential | Potential |
| Consumer Products | Community members, contractors, and repairmen disturbing consumer products containing contaminated vermiculite | Potential | Potential | Potential |

*Occupational (past and present)*—Grace internal records indicate that workers were exposed to high levels of Libby asbestos in the air at the plant in the past. Time-weighted averages (TWAs) for five employees monitored in the year 1976 showed TWAs ranging from 4.09 to 4.78 f/cc [10]. Most of these TWAs are higher than the current OSHA limit of 0.1 f/cc (as well as the OSHA limit of 2.0 f/cc at the time of sampling). It is likely that employee asbestos exposures for prior years were as high or higher than the 1976 findings, because some changes to reduce exposures had already been made before 1976. Because workers in the past did not wear personal protective equipment, such as respirators, the past occupational pathway is considered the most significant exposure pathway for the site. It is unknown how many years workers were exposed to high levels of asbestos, but ATSDR did locate records from later personnel monitoring showing significantly lower asbestos exposure in 1986 (0.017 f/cc and 0.012 f/cc for the two workers monitored).

The facility building was cleaned by Grace, and sampling showed that it was free of detectable levels of asbestos fibers when Grace sold the property. This supports the conclusion that it is unlikely that occupants of the facilities operating since then were exposed in the past or are currently being exposed to hazardous levels of Libby asbestos. The data collected have some limitations; that is, they may not have represented actual exposures possible. Further sampling would further confirm this conclusion.

*Household contact (past and present)*—In the past, persons living with the workers could have inhaled Libby asbestos coming off of clothing or hair of workers returning home from work. Plant operations were dusty, and the plant did not have facilities for workers to shower before going home. This pathway was therefore likely to be important for the site.

Because limited data available indicates that the present occupational pathway is unlikely to result in Libby asbestos exposure to workers, the present household contact pathway is also unlikely to result in significant exposures to household contacts of current workers.

*Waste piles (past and present)*—No documentation was available on storage of waste rock (stoner rock) from the process. The waste was removed from the site on a regular basis by a contracted disposal company. At other facilities of this type, waste rock was stored in piles on the site before removal [11]. Although the site is not in a residential area, if children played on the waste piles they could have inhaled Libby asbestos fibers. People handling the waste could also have inhaled Libby asbestos fibers. Contact with waste piles is a potential past pathway of exposure. No piles are currently on the site, and therefore this pathway does not present a current risk.

*Ambient air (past)*— The present ambient air pathway is considered incomplete and is eliminated from further consideration because the plant is no longer operating. In the past, while the plant was operating, community members could have been exposed to Libby asbestos fibers released into the ambient air from the furnace stack or from fugitive dusts. Available wind rose data from a monitoring station 8 miles northeast of the site suggest that winds in the mid-1970s blew predominantly in a north-south and northwest-southeast direction. (This information is shown in Figure 2.) However, no estimate of risk from this exposure pathway can be made. It is unlikely that sufficiently detailed plant-specific emission information will ever be available, and if it were, it would still be difficult to reconstruct past exposures, given the lack of knowledge of such factors as past weather patterns or people's activity patterns. The lack of concrete information results in the past ambient air pathway being characterized as an indeterminate public health hazard. However, due to dispersion and changing wind patterns, the level of exposure from the ambient air would be much lower than the high-level exposure experienced by former plant workers and thus less likely to lead to adverse health effects.

*Residential outdoor (past and present)*— Whether people ever hauled contaminated materials away for personal use is unknown; if they did, people could be exposed to asbestos from those materials. Because of the lack of information, this pathway is considered an indeterminate public health hazard.

*Residential indoor (past and present)*—Residents could have inhaled Libby asbestos fibers from household dust, either from plant emissions that infiltrated into homes or from dust brought inside from waste products brought home for personal use. There is no information on past levels of contamination in ambient air; however, it appears unlikely that past ambient air emissions would have been high enough to infiltrate significantly into houses about a quarter of a mile away. No information has been gathered about community members using waste materials in their yards. There is not enough information to evaluate whether this exposure pathway is likely to be significant for the site.

*On-site (present)*—Trace amounts of Libby asbestos have been detected in the soil around the plant. It has been shown that disturbing soils with even trace amounts of Libby asbestos can result in airborne Libby asbestos at levels of concern [21]. The area around the site is not frequently accessed, but anyone disturbing the material could be exposed. This pathway is considered an insignificant exposure pathway at the present time because people rarely contact the contaminated areas, if at all, but a potential future hazard exists if the contamination remains accessible and usage of the site increases.

*Consumer products*—People who purchased and used vermiculite products may be exposed to asbestos fibers from using those products in and around their homes. At this time, determining the public health implication of commercial or consumer use of vermiculite products (such as home insulation or gardening products) is beyond the scope of this evaluation. However, studies have shown that disturbing or using these products can result in airborne asbestos fiber levels higher than occupational safety limits [21,29]. Additional information for consumers of vermiculite products has been developed by EPA, ATSDR, and NIOSH and provided to the public (see www.epa.gov/asbestos/insulation.html).

*Future Pathways*—Present exposure pathways are expected to continue into the future unless appropriate clean-up actions are taken. If people begin to access areas on site where trace levels of asbestos were measured, they might be exposed to Libby asbestos fibers from disturbing this material. Although dependent on the activity, this exposure is expected to be intermittent and of short durations compared to long-term, high-level exposures experienced by plant workers in the past and, for that reason, less likely to lead to adverse health effects.

## Health Outcome Data

Health outcome data can be used to give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (for example, the number of people who have died from a certain disease) or morbidity information (for example, the number of people in an area who have a certain disease or illness).

As discussed above in the “Occupational” Exposure Pathway section, former workers at the site were exposed to levels of asbestos fibers above current OSHA limits. The fiber levels were similar to levels which have been associated with asbestos-related disease in other groups of chronically-exposed workers [13]. No information is available about past levels of contamination around the plant or the number of people affected in the neighborhood. The Nebraska Department of Health and Human Services is performing a review of health outcome data to determine if any of the areas in the state near facilities that processed Libby vermiculite are associated with higher disease rates. Because the plant employed few workers and because people living near the site were unlikely to experience substantial exposures, the small number of potentially affected people could make it difficult to detect community-level health effects. Preliminary site-specific results of the health statistics review for this site are included in Appendix B. The ATSDR Division of Health Studies will release annual reports summarizing health statistics review findings for all sites for which data have been received.

In Libby, Montana, the number of recorded deaths associated with asbestos-related diseases was significantly elevated (as compared with the state or the nation as a whole), especially among former workers of the vermiculite mine and their household contacts [27]. Former workers and their household contacts also showed higher rates than expected of pleural (lung lining) abnormalities, indicating higher exposure and a higher risk for developing asbestos-related disease [28]. Limited past data indicates that fiber levels in the processing areas of Libby and vermiculite processing facilities were similar, suggesting that worker exposures might have also been similar. Therefore, it is likely that former workers at the Western Mineral Products plant in Omaha and their household contacts have an increased risk of developing asbestos-related disease.

**Summary of Removal and Remedial Actions Completed and Proposed**

- There has been no clean-up action taken by EPA at the site. EPA Region 7 plans no further action at the site.

**Child Health Considerations**

ATSDR recognizes that infants and children might be more vulnerable than adults to exposure in communities faced with environmental contamination. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

The effects of asbestos on children are thought to be similar to the effects on adults. However, children could be especially vulnerable to asbestos exposures due to the following factors:

- Children are more likely to disturb fiber-laden soil or indoor dust while playing.
- Children are closer to the ground and thus more likely to breathe contaminated soil or dust.
- Children could be more at risk than people exposed later in life because of the long latency period between exposure and onset of asbestos-related respiratory disease.

The most at-risk children are those who were household contacts of workers at the time the plant was operating. The plant is no longer operating and children would not likely play around the site. Therefore, it is unlikely that children today are exposed to vermiculite contaminated with Libby asbestos near the former Western Mineral Products plant in Omaha.

## Conclusions

- Workers at the Western Mineral Products plant in Omaha were exposed to hazardous levels of Libby asbestos in the past. Workers' families are likely to have been exposed to hazardous levels of Libby asbestos through household contact in the past. The occupational and household contacts pathways represent a past public health hazard.
- There is not enough information to determine the extent to which people living in the neighborhood of the plant were exposed to Libby asbestos in the past from the ambient air pathway, the residential indoor pathway, the residential outdoor pathway, or the waste piles pathway. These pathways pose an indeterminate public health hazard. However, the risk of adverse health effects from these past pathways would be small compared to the past occupational and household contacts pathways.
- Based on the limited past data available, it is unlikely that occupants of the facilities operating since the Western Minerals plant ceased operations were exposed to hazardous levels of Libby asbestos. Further sampling of the facilities could be used to confirm this conclusion.
- Trace Libby asbestos contamination present around the plant could pose a public health hazard if disturbed. Currently, adverse health effects are unlikely because current workers or other people are not frequently in the areas that are contaminated. Future exposure is possible if these areas become used more often and action is not taken to contain the contamination.

## Recommendations

- Identify former workers and their families for possible evaluation of health effects associated with Libby asbestos exposure.
- Develop a plan for reducing the possibility of frequent and/or regular contact with soil containing trace levels of Libby asbestos.
- Provide information to increase awareness of the site owner about potential residual asbestos at the site.
- Contact former workers and request more detailed information about waste disposal and operating practices at the facility to assist in exposure analysis.

## Public Health Action Plan

The public health action plan for the site contains a description of actions that will be taken by ATSDR and/or others at the site. The purpose of the public health action plan is to ensure that public health hazards are not only identified, but that a plan of action is designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. ATSDR is committed to follow up on the plan to ensure its implementation. Following are the public health actions to be implemented.

- The property owner plans to pave uncovered soil in the back of the site. Because this would prevent people from contacting asbestos fibers in the soil, ATSDR considers this action to be protective of public health. Appropriate dust control measures should be implemented to prevent suspension of fibers during the paving process.
- ATSDR or its state partners, or both, will study the feasibility of conducting worker and household contact follow-up activities.
- ATSDR will notify the current owner of the facility about potential residual asbestos contamination at the site.
- ATSDR will combine the findings from this health consultation with findings from other health consultations on sites that processed vermiculite from Libby and develop a national summary report of the overall conclusions and strategy for addressing the public health implications.
- ATSDR will provide educational materials and references, upon request, to community members concerned about products containing vermiculite.
- ATSDR will review any new information that becomes available to determine appropriate site-specific public health actions.
- ATSDR will publish annual reports summarizing results of health statistics reviews for the vermiculite processing sites.

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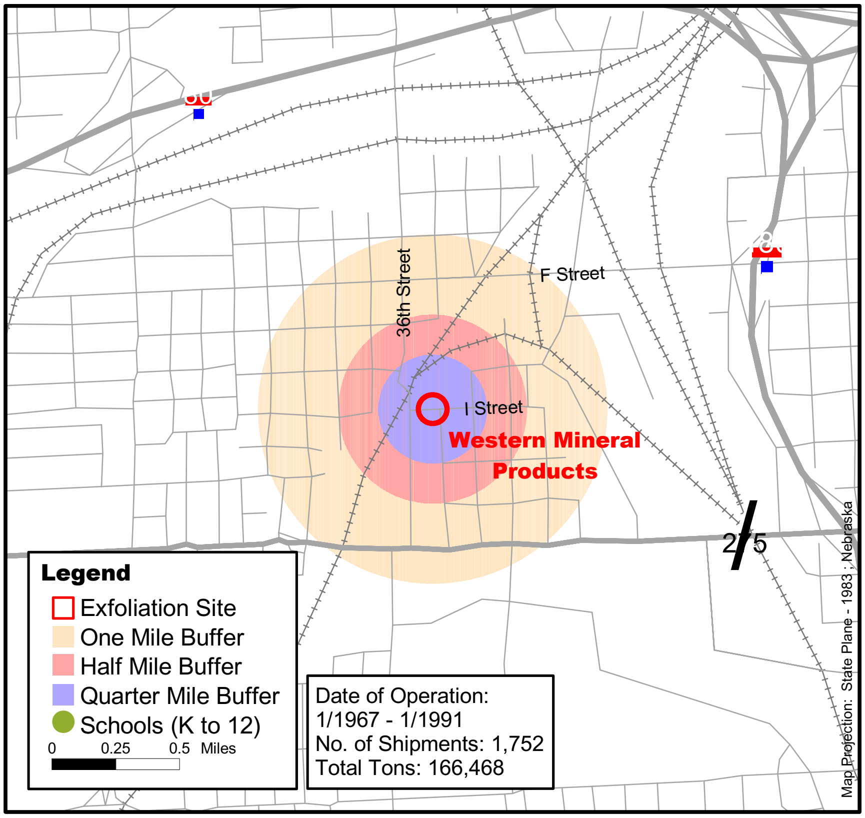
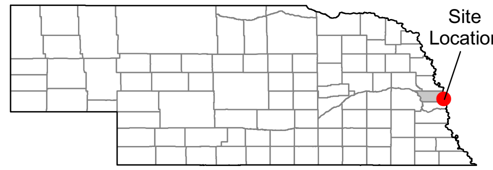
# Western Mineral Products Co

FIGURE 1.

## 3520 South I St
## Omaha, Nebraska




Base Map Source: 1995 TIGER/Line Files



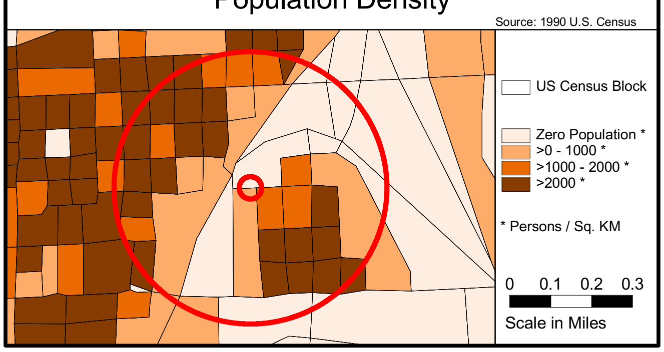

**Region 7**

Douglas County, Nebraska

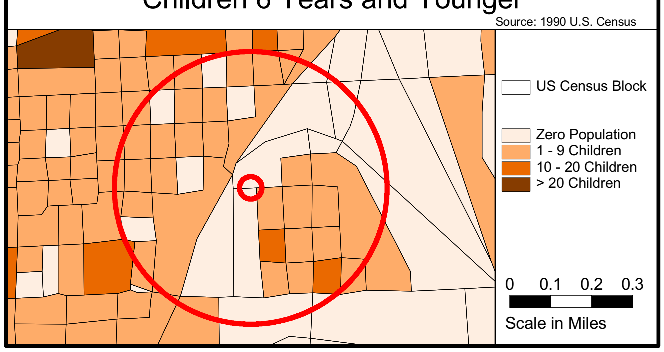
| Demographic Statistics<br>Within One Mile of Site* | |
|---|---|
| Total Population | 121 |
| White | 118 |
| Black | 1 |
| American Indian, Eskimo, Aleut | 0 |
| Asian or Pacific Islander | 0 |
| Other Race | 2 |
| Hispanic Origin | 6 |
| Children Aged 6 and Younger | 9 |
| Adults Aged 65 and Older | 27 |
| Females Aged 15 - 44 | 24 |
| Total Housing Units | 51 |

Demographics Statistics Source: 1990 US Census
*Calculated using an area-proportion spatial analysis technique

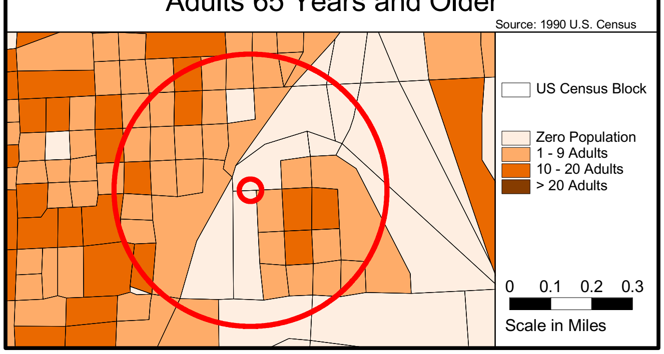
### Population Density



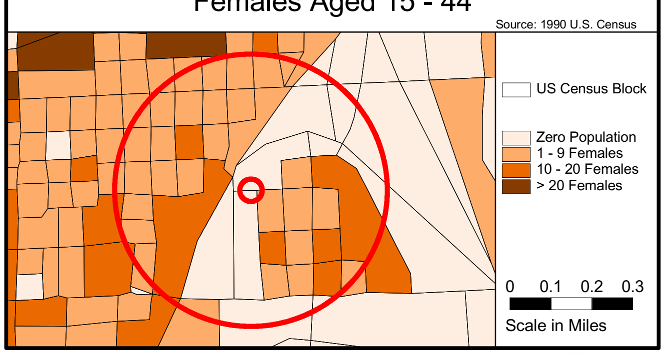

### Children 6 Years and Younger




### Adults 65 Years and Older




### Females Aged 15 - 44

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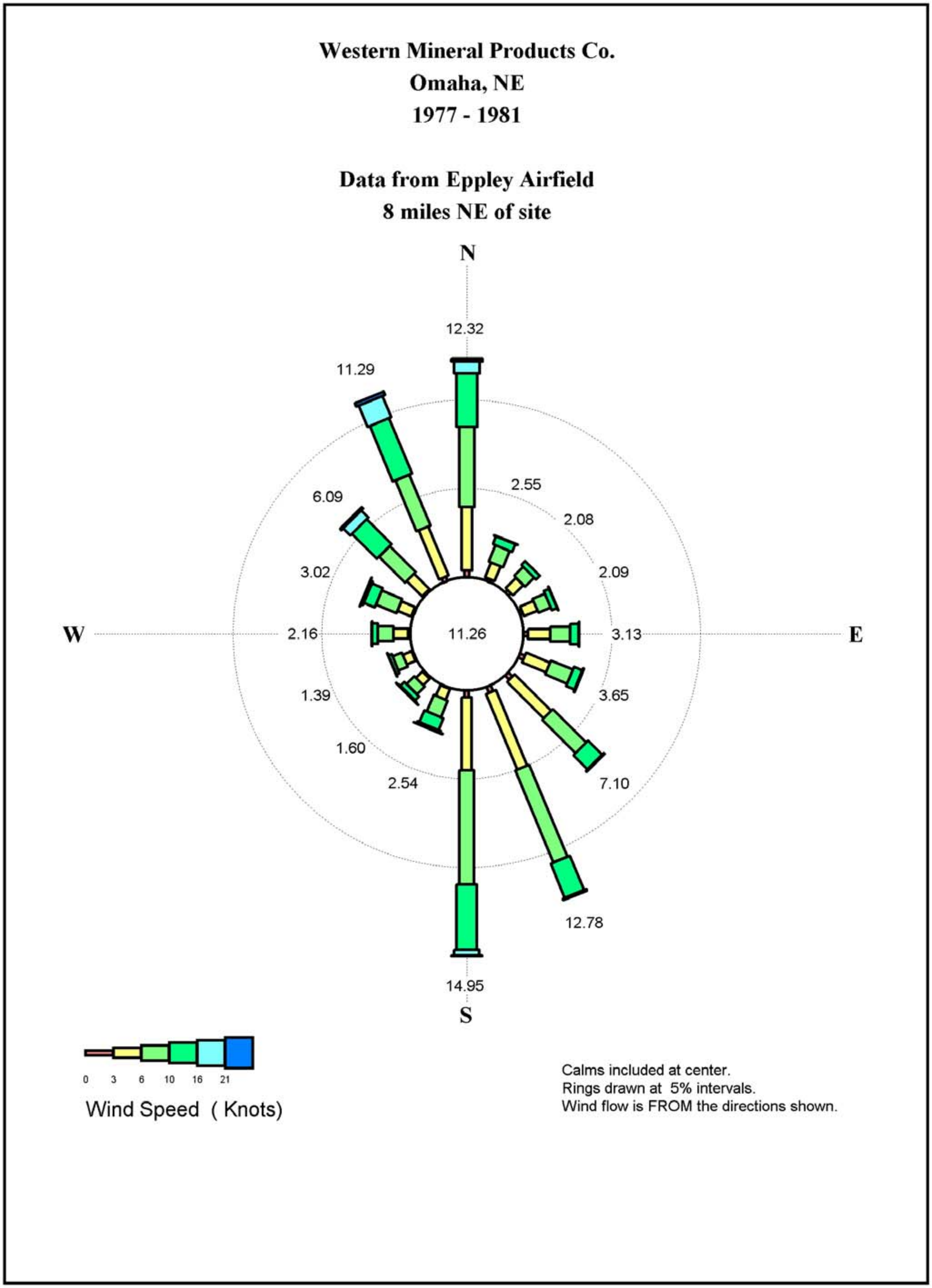
ATSDR GIS SAIDS

FIGURE 2.


Western Mineral Products Co.
Omaha, NE
1977 - 1981
Data from Eppley Airfield
8 miles NE of site
N
S
E
W
12.32
11.29
6.09
3.02
2.16
1.39
1.60
2.54
14.95
12.78
7.10
3.65
3.13
2.09
2.08
2.55
11.26
0
3
6
10
16
21
Wind Speed ( Knots)
Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.

## Appendix A. Exposure Pathways—Vermiculite Processing Facilities

**Source for All Pathways: Libby Asbestos-contaminated Vermiculite from Libby, Montana**

| Pathway Name | Environmental Media and Transport Mechanism | Point of Exposure | Route of Exposure | Exposure Population | Time |
|---|---|---|---|---|---|
| Occupational | Suspension of Libby asbestos fibers or contaminated dust into air during materials transport and handling operations or during processing operations | Onsite | Inhalation | Former workers | Past |
| | Suspension of Libby asbestos fibers into air from residual contamination inside former processing buildings | Inside former processing buildings | Inhalation | Current workers | Present, future |
| Household Contact | Suspension of Libby asbestos fibers into air from dirty clothing of workers after work | Workers' homes | Inhalation | Former and/or current workers' families and other household contacts | Past, present, future |
| Waste Piles | Suspension of Libby asbestos fibers into air by playing in or otherwise disturbing piles of vermiculite or waste rock | Onsite, at waste piles | Inhalation | Community members, particularly children | Past, present, future |
| Residential Outdoor | Suspension of Libby asbestos fibers into air by disturbing contaminated vermiculite brought offsite for personal uses (gardening, paving driveways, traction, fill) | Residential yards or driveways | Inhalation | Community members | Past, present, future |
| Residential Indoor | Suspension of household dust containing Libby asbestos fibers from plant emissions, or residential outdoor waste | Residences | Inhalation | Community members | Past, present, future |
| Ambient Air | Stack emissions and fugitive dust from plant operations into neighborhood air | Neighborhood around site | Inhalation | Community members, nearby workers | Past |
| Onsite Soils | Suspension of Libby asbestos fibers into air from disturbing contaminated material remaining in onsite soils (residual soil contamination, buried waste) | Areas of remaining contamination at or around the site | Inhalation | Current onsite workers, contractors, community members | Present, future |
| Consumer Products | Suspension of Libby asbestos fibers into air from using or disturbing insulation or other consumer products containing Libby vermiculite. | Homes where LA-contaminated products were/are present | Inhalation | Community members, contractors and repairmen | Past, present, future |

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# Appendix B. Health Statistics Review for Populations Near the Western Mineral Products Site in Omaha, Nebraska

## Background

Through an analysis of mortality records, ATSDR and the Montana Department of Public Health and Human Services detected a statistically significant excess of asbestos-related disease (asbestosis) among residents of Libby, Montana [1]. Rates of asbestosis were 60 times higher than the national rates, a difference that is highly unlikely to occur from natural fluctuations in the occurrence of this disease. This discovery led to several follow-up public health activities in Libby to address the health impacts on the community [2, 3]. Another follow-up activity is a nationwide effort to screen for a similar impact on the health of persons in communities near facilities that processed or received vermiculite ore from Libby. As part of this activity, ATSDR is currently working with 25 state health departments including the Nebraska Department of Health and Human Services (NDHHS) to conduct health statistics reviews on sites that may have received the asbestos-contaminated Libby ore. Health statistics reviews are statistical analyses of existing health outcome data (for example, data from cancer registries or death certificates) that help provide information on whether people living in a particular community have developed selected diseases more often than a comparison population (that is, people living in the rest of the country). Finding an excess of asbestos-related diseases in a community through analysis of a health statistics review would alert ATSDR and NDHHS to the possibility that workers or community members might have been exposed to Libby asbestos from the vermiculite ore. Participating state health departments are conducting health statistics reviews for communities near vermiculite facilities, regardless of whether it is known if the community was exposed to Libby asbestos through the processing or handling of vermiculite ore. ATSDR developed the methodology for the health statistics review used for the Western Mineral Products Company site in Omaha and for other vermiculite sites across the United States [4].

## Methods

Only mortality (that is, death certificate) data were used for this analysis. Cancer registry data was not used in this analysis because the years of data requested by ATSDR (1986–1995) are not available from NDHHS (NDHHS has complete cancer registry data for the years 1996–2001). The target population for the mortality analysis consisted of people who died of potential asbestos-related and other diseases while residing within census tract 31 (population 3,147 according to US Census 1990 data). This census tract was chosen because (1) it contains the Western Mineral Products Company site located at 3520 I Street in Omaha, Nebraska (zip code 68107) and (2) it represents the smallest geographic area surrounding the site that is electronically coded on Nebraska death certificates. Furthermore, utilizing the city boundaries of large metropolitan areas such as Omaha can be problematic because they have a greater chance of containing other potential asbestos sources (such as chemical and rubber manufacturing plants). To filter out other potential asbestos sources, NDHHS chose to analyze the smallest geographic area possible.

The mortality analysis period chosen was from 1979–1998. This period was chosen because (1) it covered the most recent 20 years of mortality data available at the time the analysis began, (2) it corresponded to an approximate latency period in which initial exposure occurred and death would be expected, and (3) only one International Classification of Disease (ICD) revision is used. There were 12 disease groupings used for this mortality analysis (Table B–1). Of the 12 groupings, the three of greatest interest to ATSDR were the ones that have a known association with asbestos exposure. These three include asbestosis (ICD-9 501); malignant neoplasm of peritoneum, retroperitoneum, and pleura (ICD-9 158 and 163), which includes mesothelioma; and malignant neoplasm of lung and bronchus (ICD-9 162.2–162.9). The other 9 disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting or coding anomalies in the analysis areas.

Sex-specific age-standardized mortality ratios (SMRs) were calculated for asbestos-related deaths. The SMRs were calculated to measure whether the number of people who died from selected diseases in the Omaha target area is the same as, or lower or higher than, the number of people we would expect to find in a comparison population. The comparison population used in this analysis was the population in the rest of the United States, and the data used was national death certificate data received from the National Center for Health Statistics [5]. If the number of people who died from selected diseases in a target area is the same as the number we would expect to find, the SMR will equal 1. If the number of persons in the target area who died from selected diseases is less than expected, the SMR will be between 0 and 1. If the number of citizens in the target area who died from selected diseases is more than would be expected, the SMR will be greater than 1.

Ninety-five percent confidence intervals (95% CIs) were calculated to assess statistical significance (6). A confidence interval is a range of possible values for the SMR that are considered consistent with the normal variation in disease over time in a geographic area. The confidence interval consists of two numbers -- the lower bound and the upper bound of the range of normal SMR values. If both the lower and upper bound numbers of the confidence interval are less than 1, then the conclusion of the statistical test is that a disease is occurring less frequently in the Omaha community than it is in the US population. This is called a "statistically significant decrease" or a "statistically significant deficit". If the lower bound number is less than 1 and the upper bound number is greater than 1, then the conclusion of the statistical test is that a disease is occurring in the Omaha community at the same frequency as in the US population (or cannot be distinguished from normal fluctuations using this statistical technique). This is called "not statistically significantly different"). Lastly, if both of the numbers in the confidence interval are higher than 1, then the conclusion of the statistical test is that a disease is occurring more frequently in the Omaha community than it is in the rest of the country. This is called a "statistically significant increase" or a "statistically significant excess".

## Results

Table B-1 shows, for each disease group analyzed (1) whether past studies have shown a link between asbestos exposure and that type of disease; (2) the number of persons in the Omaha target area who developed the specified disease; (3) the number of persons we would expect to develop the specified disease if the community had the same occurrence of disease as the rest of the US population; (4) the SMR; and (5) the 95% confidence interval for the SMR.

For the time period 1979–1998, 4 of the 12 disease groupings in the Omaha target area had SMRs equal to or less than 1 (Table B–1). In the remaining eight disease groupings, SMRs were greater than one; however, seven of these SMRs were not statistically significant and were within the normal range of what would be expected. The disease grouping for the target area that was significantly higher than expected was for all malignant neoplasms (ICD-9 140-208). Because of the limitations in using existing data sources, this elevation does not necessarily mean that a true excess exists (see Discussion and Limitations).

## Discussion and Limitations

The main goal of conducting these health statistics reviews is to help determine whether communities near facilities that received Libby vermiculite have higher than expected occurrences of asbestos-related diseases. The SMR analysis suggests that the death rates of known asbestos-related diseases (that is, mesothelioma, asbestosis, lung cancer) in the Omaha target area do not appear to be significantly higher than expected compared with the rest of the country. While the disease grouping *all malignant neoplasms* (ICD-9 140–208) was significantly higher than expected, this grouping was mainly used in this analysis to evaluate reporting or coding anomalies in the study area. Because cancer is made up of hundreds of different diseases, each type of cancer has different risk factors. For this reason, it is better to focus on a specific cancer site of concern (such as lung cancer) when calculating rates instead of looking at all cancers together.

There are many limitations to using existing data sources to examine the relationship between environmental exposures and diseases that develop over a long period of time). Some of the major limitations in this analysis include, but are not limited to, exposure misclassification, population migration, lack of control for confounding factors (such as data on smoking status), disease misclassification, large study areas, and small numbers of deaths. Most of these limitations would make it less likely that this type of analysis would identify a higher than expected occurrence of asbestos-related deaths among people who lived near the Western Mineral Products Company site in Omaha during its years of operation.

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**Table B–1. Mortality data findings for residents of census tract 31 who died from selected diseases in close proximity to the Western Mineral Products target area in Omaha, Nebraska, 1979–1998**

| Selected Disease | Past studies have shown a link to asbestos exposure? | Number of people who died | Expected number of deaths* | SMR† | 95% Confidence Interval‡ | |
|---|---|---|---|---|---|---|
| | | | | | Upper | Lower |
| Malignant neoplasm of selective digestive organs (ICD-9 150–154, 159) | Weak link | 37 | 27.0 | 1.4 | 1.0 | 1.9 |
| Malignant neoplasm of respiratory system and intrathoracic organs (ICD-9 161–165) | Yes | 62 | 47.5 | 1.3 | 1.0 | 1.7 |
| Malignant neoplasm of lung & bronchus§ (ICD-9 162.2–162.9) | Yes | 61 | 45.9 | 1.3 | 1.0 | 1.7 |
| Malignant neoplasm of peritoneum, retroperitoneum, and pleura (includes mesothelioma)§ (ICD-9 158, 163) | Yes | 0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Malignant neoplasm without specification of site (ICD-9 199) | No | 10 | 10.3 | 1.0 | 0.5 | 1.8 |
| Diseases of pulmonary circulation (ICD-9 415–417) | No | 5 | 3.8 | 1.3 | 0.4 | 3.1 |
| Chronic obstructive pulmonary disease (ICD-9 490–496) | No | 34 | 28.8 | 1.2 | 0.8 | 1.6 |
| Asbestosis§ (ICD-9 501) | Yes | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Other diseases of respiratory system (ICD-9 510–519) | No | 8 | 4.9 | 1.6 | 0.7 | 3.2 |
| All malignant neoplasms (ICD-9 140–208) | No | 202 | 161.6 | 1.2 | 1.1¶ | 1.4 |
| Malignant neoplasm of female breast (ICD-9 174) | No | 18 | 12.7 | 1.4 | 0.8 | 2.2 |
| Malignant neoplasm of prostate (ICD-9 185) | No | 9 | 9.59 | 0.9 | 0.4 | 1.8 |

* Calculated using unpublished mortality data received from the National Center for Health Statistics (5).
† The standardized mortality ratio (SMR) equals the number of people who died divided by the expected number of deaths.
‡ The 95% confidence intervals were calculated to assess statistical significance using Byar's approximation (6).
§ Known associations with asbestos exposure. The other disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting or coding anomalies in the target area.
¶ Statistically significant.