UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

DATE: February 10, 2002

SUBJECT: NYC DEPARTMENT OF HEALTH MISREPRESENTATIONS
February 8, 2002 press release:
"NYC Department of Health Presents Findings from Indoor Air Sampling in Lower Manhattan"

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TO: Affected Parties and Responsible Officials

A February 8, 2002 press release from the New York City Department of Health (NYC DOH) (attached) contains an interpretation of preliminary data from a study not yet released by the Agency for Toxic Substances and Disease Registry (ATSDR) of the Centers for Disease Control (CDC). This study conducted tests in apartments and buildings in lower Manhattan which were impacted by fallout from the collapse of the World Trade Center (WTC).

The ATSDR does not plan releasing the study or preliminary results to the public until spring, so it is difficult to determine whether or not the NYC DOH correctly represented the data. However, there is at least one major clear misrepresentation of the data by the NYC. There is evidence of other misrepresentations as well.

[1] The conclusions and opinions in this memorandum are those of the author and do not necessarily reflect those of the U.S. Environmental Protection Agency.

AIRBORNE ASBESTOS

The NYC DOH made the following claim in its press release:

> The air samples from inside the buildings showed no elevated levels of asbestos. [NYC DOH]

The DOH does not mention in its press release exactly what the level of asbestos would be considered "elevated." However, the press release refers readers to the NYC Department of Environmental Protection (NYC DEP) for more information. The cited NYC DEP web page (attached) states that the "safe" level, or standard, is 0.01 fibers per cubic centimeter (f/cc) (which is the same as fibers/milliliter):

> The US and NYC standard for asbestos in community and residential buildings is 0.01 fibers/cubic centimeter (f/cc) [same as f/mL] in indoor air. ... As testing continues, there may be the possibility of occasional short-term increases in levels of asbestos in the air above the residential standard of 0.01 f/cc of air. [NYC DEP]

This is a misrepresentation. Due to the many public discussions over the safe level of asbestos in air, there can be no misunderstanding on the part of either the NYC DOH or DEP that the residential or ambient air standard of the U.S. Environmental Protection Agency (EPA) is 0.01 f/mL. And by law, any state or city standards for asbestos must be at least as stringent as the federal EPA standard.[2]

EPA standard for asbestos

The EPA standard for asbestos in indoor and outdoor air is found in its Integrated Risk Management Information System (IRIS), attached, and other public documents. It is the policy and goal of EPA to protect at the 1 in a million cancer risk level (10^{-6} risk level), the point of departure. In all cases, action by EPA is triggered by any risk greater than 1 in 10,000. The EPA air standards for asbestos in inside and outside air at the different risk levels are given in the table below:

CANCER RISK LEVEL		AIR CONCENTRATION OF ASBESTOS
number of cancers	risk level	fibers per milliliter (f/mL), "PLM" fraction of fibers over 5 micrometers long
1 in 1,000,000	10^{-6} (= E-6)	0.000004 f/mL (= 4E-6 f/mL)
1 in 100,000	10^{-5} (= E-5)	0.00004 f/mL (= 4E-5 f/mL)
1 in 10,000	10^{-4} (= E-4)	0.0004 f/mL (= 4E-4 f/mL)

[2] The EPA itself has erroneously referred to the AHERA TEM test level of 70 structures per square millimeter as a "standard" on its website at http://www.epa.gov/epahome/wtc/activities.htm.

The safe level and goal of EPA, the actual air standard, is 0.000004 f/mL, and the action level for EPA to trigger a cleanup is 0.0004 f/mL. **The EPA standard is thus 2500 times lower** than the 0.01 f/mL level claimed to be the standard by the NYC DOH and DEP.

It is particularly important to test asbestos at the 10^{-6} risk level, because other carcinogens and possible carcinogens are potentially present in WTC fallout, including fiberglass, dioxins, PCB's, and heavy metals. If several are present, the carcinogenic risk could be additive and result in a higher aggregate cancer risk.

Origin of NYC claim that their standard and the US standard is 0.01 f/mL

The NYC DOH and DEP are apparently basing their claim that the standard is 0.01 f/mL on a particular test that must be conducted while using a one-horsepower leaf blower to stir up all the asbestos in a room after certified professional abatement. This is the AHERA TEM clearance test (Asbestos Hazard Emergency Response Act transmission electron microscopy).

The EPA regulations for conducting the AHERA TEM clearance test are contained in Title 40 of the Code of Federal Regulations, Part 763, Appendix A. Regulations are implementations of statutes, and thus are the law and legally binding. States and cities must adopt these regulations or have more stringent regulations. The AHERA TEM clearance test is a TEST, not an air STANDARD. Nowhere in any of the EPA regulations is the 0.01 f/mL level called a "standard" for air. The procedures for this test are given in part below:

> 40 CFR - CHAPTER I - PART 763
> Appendix A to Subpart E -- Interim Transmission Electron Microscopy Analytical Methods -- Mandatory and Nonmandatory -- and Mandatory Section to Determine Completion of Response Actions
> . . .
> II. Mandatory Transmission Electron Microscopy Method
> A. Definitions of Terms
> 1. *Analytical sensitivity* -- Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 structures/cm 3. . .
> 14. The final plastic barrier around the abatement area remains in place for the sampling period.
> 15. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust. (See suggested protocol in Unit III.B.7.d.) . . .
> 17. A minimum of 13 samples are to be collected for each testing site consisting of the following:
> a. A minimum of five samples per abatement area.
> b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.
> . . .

[Unit III.B.]7. Abatement area sampling.

a. Conduct final clearance sampling only after the primary containment barriers have been removed; the abatement area has been thoroughly dried; and, it has passed visual inspection tests by qualified personnel. (See Reference 1 of Unit III.L.)
b. Containment barriers over windows, doors, and air passageways must remain in place until the TEM clearance sampling and analysis is completed and results meet clearance test criteria. The final plastic barrier remains in place for the sampling period.
c. Select sampling sites in the abatement area on a random basis to provide unbiased and representative samples.
d. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust.
    i. Equipment used in aggressive sampling such as a leaf blower and/or fan should be properly cleaned and decontaminated before use.
    ii. Air filtration units shall remain on during the air monitoring period.
    iii. Prior to air monitoring, floors, ceiling and walls shall be swept with the exhaust of a minimum one (1) horsepower leaf blower.
    iv. Stationary fans are placed in locations which will not interfere with air monitoring equipment. Fan air is directed toward the ceiling. One fan shall be used for each 10,000 ft 3 of worksite.
    [40 CFR 763, App. A]

The reason that the EPA designed the AHERA TEM clearance test, requiring first certified asbestos abatement procedures followed by a leaf blower, and then a fan, followed by air testing to the 0.01 f/mL (PCM) level (equivalent to 0.02 s/mL or 70 structures per square millimeter) was to save costs and time. EPA found that using a leaf blower increased asbestos concentrations in air by thousands of times. One study showed that using a leaf blower increased airborne asbestos concentrations over 100 times that caused by even vigorous broom cleaning.[3] And vigorous broom cleaning has been demonstrated to increase asbestos levels hundreds or thousands of times over that of passive conditions which do not disturb dusts. Testing at the low levels that are actually those of health concern, 0.000004 f/mL, can often take 24 or more hours, which was found to be impractical for asbestos abatement contractors.

Even if testing is done at the low levels associated with asbestos health effects (0.000004 f/mL), there must be human activities or simulated human activities in the same room at the same time of the testing. When testing airborne asbestos levels inside homes in Libby, Montana, the Superfund site, EPA had both stationary air monitors and monitors worn by residents going about their normal daily activities. See the attached risk assessment for the Libby site for a description. Another study showed that asbestos concentrations in air can be undetectable or below 0.005 f/mL when there are no activities in the room to stir up dusts, but as high as 0.09 to 54 f/mL when activities such as vacuuming, broom sweeping, gym activities, etc. are going on in

[3] Millette, J., *et al.* Applications of the ASTM Asbestos in Dust Method D5755. In: Advances in Environmental Measurement Methods for Asbestos, ASTM Special Technical Publication 1342.

the room to disturb the dusts.[4]

The following table gives the legal/legitimate and illegal/illegitimate ways to determine whether asbestos levels in air in homes, offices, or schools meets EPA standards:

LEGAL/LEGITIMATE AIRBORNE ASBESTOS TESTING METHODS		ILLEGAL/ILLEGITIMATE AIRBORNE ASBESTOS TESTING METHODS	
0.000004 f/mL (PCM) laboratory sensitivity (detection limit), the EPA safe level. Conditions of actual or simulated human activities, such as a child jumping on a contaminated couch or rolling around on contaminated carpet	0.01 f/m (PCM) = 0.02 s/mL (all fibers) = 70 structures per square millimeter Testing for this level ONLY AFTER the following conditions, as required by law in 40 CFR 763: 1. Completion of professional certified asbestos abatement 2. Suspension of dusts by using one-horsepower leaf blower followed by fans during actual testing.	0.000004 f/mL (PCM) laboratory sensitivity (detection limit), the EPA safe level. Passive conditions, *i.e.*, no activities to disturb dusts to cause them to be airborne.	0.01 f/m (PCM) = 0.02 s/mL (all fibers) = 70 structures per square millimeter This level under either passive testing conditions (no human activity) or even normal human activities

Probable testing methods of the CDC's ATSDR

Although we do not know what methods the ATSDR used to test air inside buildings, it is doubtful that they utilized techniques that can detect asbestos at the 0.000004 f/mL level. If the ATSDR did test at this low level, it is unknown whether there were simulated or actual human activities taking place at the same time to disturb the dusts.

It is also doubtful that if they tested the air using less sensitive methods, that they used the aggressive leaf-blower conditions required for the AHERA TEM test. It would be impossible to use the aggressive leaf-blower test conditions in currently occupied spaces, as it could contaminate surfaces that had previously been cleaned. However, this is no excuse, since there are plenty of unoccupied apartments and business spaces which could be sealed off and tested, and contaminated carpeting and upholstered furniture from the same building could be placed in the space to be tested. (It would be a minor cost to purchase the carpeting or furniture from other tenants in the building.)

[4] Millette, J. R., and Hays, S. M. (1994), Chapter 8, Resuspension of Settled Dust, in: *Settled Dust Sampling and Analysis*, page 63, Table 2, Lewis Publishers, ISBN 0-87371-948-4.

INDOOR DUST TESTING

The NYC DOH described the results of the indoor dust testing as follows:

> Testing was also conducted in four buildings above 59th Street to provide information on the background level of various substances present indoors in New York City.
> . . .
> The analysis of 98 dust samples for asbestos taken from the inside and outside of residential buildings in lower Manhattan indicated that while 20% were above background levels, only two samples which were taken from outdoors required abatement. Professional abatement work was completed in this area.
>
> Samples taken from inside and outside of residential buildings in lower Manhattan were analyzed for fibrous glass. Fibrous glass was detected in 43 of the 98 samples taken. The results of air sampling for fibrous glass, and for air and surface testing of other materials, are not yet available.

It is alarming that 20% of samples from indoors (or this could be both indoors and outdoors) were over background levels. Although it was not stated, there could also be more than 20% of the indoor dusts that had detectable levels of asbestos, but which were not over background. At the Libby, Montana Superfund site (see attachment), only 11 to 23% of the indoor dust samples had detectable asbestos from the random homes selected in Phase 1 of the Libby investigation.

It is also inappropriate for the NYC DOH to establish background by going to other areas of Manhattan. The buildings above 59th Street could have been contaminated with WTC fallout, or could be contaminated from other sources of asbestos. These "background" buildings might also have unsafe levels of asbestos and require professional abatement. It is an unfair comparison to imply that only 20% of the inside building dusts in Lower Manhattan had elevated levels that required abatement, based on a comparison to levels in buildings above 59th Street, which might themselves be unsafe.

The finding of fibrous glass (fiberglass) in 44% of the samples is also alarming. It is also unfortunate that the ATSDR did not test for other hazardous substances, such as dioxins, PCB's, and heavy metals such as mercury.

OUTDOOR DUST TESTING

The NYC DOH made the following statement regarding outdoor dusts:

> The analysis of 98 dust samples for asbestos taken from the inside and outside of residential buildings in lower Manhattan indicated that while 20% were above background levels, only two samples which were taken from outdoors required abatement. Professional abatement work was completed in this area.

Although the NYC DOH does not state what level they consider to be a "safe" level in the outdoor dusts that triggered professional abatement, it can be deduced. The NYC DEP issued a letter on October 25 to residents of Lower Manhattan, stating that professional abatement was only necessary if indoor dusts contained 1% asbestos or higher. See attached.

The 1% asbestos level is not considered to be a "safe" level by the EPA. It is not a risk-based number. It was developed to apply to the asbestos products themselves that were used in homes and other buildings, because it was found that these products always contained 1% or more asbestos. The dusts in a building that used these asbestos materials would always have lower levels of asbestos than the asbestos materials themselves. The EPA regulations require the removal or management in-place of the asbestos materials (at 1% asbestos or higher) and then the thorough abatement of all contaminated surfaces, whether containing 1% asbestos or not.

EPA has determined that levels of asbestos lower than 1% could present hazards:[5]

> Levels of 1% or less could present a risk where there is enough activity to stir up soil and cause asbestos fibers to become airborne.

In one independent study, it was found that soils containing only 0.001% asbestos were still capable of producing measurable airborne asbestos concentrations greater than 0.01 fibers per milliliter (equivalent to structures per milliliter), which is an air concentration thousands of times higher than the EPA safe level of 0.000004 f/mL.[6]

CONCLUSIONS

The CDC's ATSDR should immediately provide the public with all the information and data that it has supplied to the NYC DOH, so that an honest evaluation can be made. Through its misrepresentations, NYC DOH is giving the public a false sense of security and the erroneous belief that exposures to asbestos and fiberglass are not hazardous, and also that there are no other hazardous substances present because the ATSDR did not test for them. Since the full study will not be released until spring, there are many months that may go by with additional needless exposures, particular during unsafe cleanups by citizens themselves.

It is a violation of the Administrative Procedures Act and the Sunshine Act for a federal entity such as the ATSDR to provide preferential treatment to the NYC DOH by the early release of

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[5] www.epa.gov/region8/superfund/libby/qsafe.html

[6] Addison, J. (1995) Vermiculite: a review of the mineralogy and health effects of vermiculite exploitation. Reg. Tox. Pharm. 21: 397 - 405.

preliminary data without simultaneously releasing the same data to the public. The fact that the NYC DOH requested the study does not entitle it to receive any results prior to the public. Oftentimes industry, public interest groups, or even individual citizens request studies by federal agencies. When any data resulting from these studies is released, it is released to all parties simultaneously. The NYC DOH has no special standing in this regard.

LIST OF ATTACHMENTS

NYC Department of Health (February 8, 2002) NYC Department of Health presents findings from indoor air sampling in Lower Manhattan. Posted ad:
http://www.nyc.gov/html/doh/html/public/press02/pr08-208.html
or www.NYenviroLAW.org

NYC Department of Environmental Protection. (Undated) Air, noise and hazardous materials. Web page posted at http://www.nyc.gov/html/dep/html/airmonit.html

U.S. EPA (August, 2001) Integrated Risk Management Information System (IRIS) Summary for Asbestos, posted at http://www.epa.gov/iris/subst/0371.htm

USEPA (2001) Appendix A to Subpart E -- Interim Transmission Electron Microscopy Analytical Methods --Mandatory and Nonmandatory -- and Mandatory Section to Determine Completion of Response Actions, 40 CFR - CHAPTER I - PART 763. Posted at:
www.epa.gov/epahome/cfr40.htm

Miele, J. A., Commissioner, NYC Department of Environmental Protection(October 25, 2001) Letter to Residents of Lower Manhattan. Posted at www.NYenviroLAW.org

Weis, C. P., Senior Toxicologist/Science Support Coordinator, U.S. EPA (December 20, 2001) Excerpts from: Amphibole mineral fibers in source materials in residential and commercial areas of Libby pose an imminent and substantial endangerment to public health. Posted at:
http://www.epa.gov/region8/superfund/libby/riskassess.html

Press Release

New York City Department of Health
Office of Public Affairs

FOR IMMEDIATE RELEASE
CONTACT: Sandra Mullin/Greg Butler
Friday, February 8, 2002
(212) 295-5335/5336

NYC DEPARTMENT OF HEALTH PRESENTS FINDINGS FROM INDOOR AIR SAMPLING IN LOWER MANHATTAN

Analysis of Air Samples Taken from Residential Buildings in Lower Manhattan Indicates

DOH Reminds Residents of Importance of Cleaning to Reduce Dust.

As part of an ongoing effort to assess the environmental impact of the World Trade Center (WTC) disaster and to respond to public health concerns, the New York City Department of Health (DOH) in collaboration with the federal Agency for Toxic Substances and Disease Registry (ATSDR) conducted indoor and outdoor tests of thirty residential buildings in lower Manhattan.

The tests examined samples of both air and dust. The air samples from inside the buildings showed no elevated levels of asbestos. The air sampling results for fibrous glass (fiberglass) are not yet available. The dust showed low levels of asbestos in some samples and the presence of fiberglass in other samples. The potential for exposure to these materials depends not only on their concentration in the dust but also on the amount of dust that is present. Asbestos and fiberglass can pose a health risk if dust accumulates and particles become airborne. While these findings are not unexpected, they underscore the importance of proper cleaning to reduce dust.

DOH is sending letters to building owners and residents informing them of the test results; flyers are also being distributed in lower Manhattan. The letters and flyers emphasize the importance of following DOH's cleaning recommendations to prevent dust from becoming airborne, especially while work continues at the WTC site. In addition to distributing information to residents, DOH is holding community meetings in association with Manhattan Community Board No. 1 to directly address any remaining concerns.

Residents are being advised to use a wet mop, damp cloth, or a high efficiency particulate air filter (HEPA) vacuum to clean dust from hard surfaces, and HEPA vacuums to clean carpets, upholstery, and other items that cannot be cleaned by wet wiping. To prevent the recirculation of dust, residents are advised not to sweep with "dry" brooms, or to use dusters or vacuums without approved HEPA filters. Since fiberglass can be irritating to the skin, rubber gloves can be used to provide skin protection. Residents were also advised to avoid carrying dust into their buildings from outdoors (e.g., by taking off shoes).

New York City Health Commissioner Thomas R. Frieden, MD, MPH said, "Since the collapse of the World Trade Center, an event that resulted in the release of large amounts of dust and other airborne particles, some residents of lower Manhattan have reported short-term health problems such as cough, and irritation of the eyes, nose, and throat. The data from air quality tests thus far have been reassuring. None of the testing to date has shown results that would indicate long-term health impacts. However, conclusive scientific knowledge about the potential health hazards of some substances is not available. DOH recognizes residents' concerns and will continue to work closely with local, state and Federal agencies to monitor air quality and to inform the public of

findings as soon as results are available." Dr. Frieden continued.

"Additionally, DOH has been working with the U.S. Centers for Disease Control and Prevention (CDC) to develop a protocol for a World Trade Center Registry, which, if funded, would generate and maintain a database that can be used as a basis for conducting studies that can provide a more complete picture of short- and long-term health and mental health impacts among the affected populations," Dr. Frieden concluded.

Sampling Summary
At the request of DOH, ATSDR conducted tests in 59 apartments in 30 geographically representative buildings in lower Manhattan in November and December 2001. Testing was also conducted in four buildings above 59th Street to provide information on the background level of various substances present indoors in New York City. Using widely accepted testing methods, the agency looked for several materials that are common building components or could potentially cause short and long-term health problems. Each set of tests included samples of air and settled dust, and these samples were analyzed for fiber-like materials - asbestos, fibrous glass - and for other particles including silica, gypsum, mica, and calcite.

A total of 117 samples were taken from 30 buildings in lower Manhattan and analyzed for airborne fibers. Samples were taken inside residences, in common areas within residential buildings, and outside of the buildings. The air samples from inside the buildings showed no elevated levels of asbestos. Levels were similar to those seen in areas not affected by the World Trade Center collapse.

The analysis of 98 dust samples for asbestos taken from the inside and outside of residential buildings in lower Manhattan indicated that while 20% were above background levels, only two samples which were taken from outdoors required abatement. Professional abatement work was completed in this area.

Samples taken from inside and outside of residential buildings in lower Manhattan were analyzed for fibrous glass. Fibrous glass was detected in 43 of the 98 samples taken. The results of air sampling for fibrous glass, and for air and surface testing of other materials, are not yet available.

Health Information about Asbestos and Fiberglass
The risk of developing these diseases from environmental exposures depends on the level and duration of exposure.

Exposure to asbestos is associated with asbestosis (scarring of the lungs) and cancer. The likelihood of developing disease from limited, short-term, low-level exposure is low. There is no reliable test that can indicate whether an individual has had low-level exposures to asbestos. In the occupational setting, where the duration and intensity of asbestos exposure can be greater, there is a higher risk to workers. Workers at the WTC site need to use the appropriate protective equipment to reduce exposure. Exposure to some forms of fibrous glass (fiberglass) can cause cough, and eye, nose, skin, and throat irritation. Long-term health effects associated with fibrous glass are not completely known and standards for measurement of fibrous glass in environmental samples are not well established. Although fiberglass is classified as a possible carcinogen, recent studies of more than 30,000 industrial workers who worked with fiberglass found no conclusive evidence of an increased risk of cancer.

Additional information about the indoor testing initiative is available on the DOH Web site at nyc.gov/health. A comprehensive report on this testing will be available this spring. Final test results will be released to the public as soon as they become available. Results of outdoor sampling since September 11 of air, water, and dust - including sampling for asbestos and particulate matter (are posted on the U.S. Environmental Protection Agency's (EPA) website, epa.gov, and can also be found on the New York City Department of Environmental Protection's (DEP) website at nyc.gov/dep. WTC-related information can also be found at nyc.gov/health.

Information on the Project Liberty program, a statewide disaster-recovery initiative that offers free crisis counseling, education, and referral services to anyone affected by the World Trade Center disaster, is available

www.nyc.gov/html/dep/html/airmonit.html

Air, Noise and Hazardous Materials

Air Monitoring in Lower Manhattan

School Data

DEP is monitoring the ambient outdoor air for asbestos. This effort is augmenting ambient air asbestos sampling being done by the EPA and other state and city agencies. There is currently no outdoor ambient standard for asbestos. The US and NYC standard for asbestos in community and residential buildings is 0.01 fibers/cubic centimeter (f/cc) in indoor air. An indoor area which has had asbestos detected and then removed must show that air samples are at or below the 0.01 f/cc standard before the indoor area can be re-occupied. Although the ambient outdoor air is being monitored, DEP is using this value as a way to characterize the levels of asbestos in the air.

Since the measurement protocol used, phase contrast microscopy (PCM), counts fibers, DEP is also conducting an additional analysis for all samples that are above 0.01 f/cc. This measurement protocol is called transmission electron microscopy (TEM) and counts the number of asbestos fibers in the sample. EPA is reporting their data in TEMs, and provides a good explanation of the interpretation of the standard that uses this methodology on their website.

Results indicate that, as expected, asbestos is present in some of the debris at the site and in areas very close to the site. Between September 28, 2001 and the present, the vast majority of air sampling results outside the security zone have been below the standards for asbestos in indoor air.

As testing continues, there may be the possibility of occasional short-term increases in levels of asbestos in the air above the residential standard of 0.01 f/cc of air. When the measured level for the outdoor ambient air is above 0.01 f/cc, the samples will be analyzed to determine how many of the fibers are actually asbestos fibers.

To view recent air monitoring results, click on a sampling location below or on the map (Links will open in a new browser window):

www.epa.gov/iris/subst/0371.htm

Asbestos (CASRN 1332-21-4)

0371

Asbestos; CASRN 1332-21-4

Health assessment information on a chemical substance is included in IRIS only after a comprehensive review of chronic toxicity data by U.S. EPA health scientists from several Program Offices and the Office of Research and Development. The summaries presented in Sections I and II represent a consensus reached in the review process. Background information and explanations of the methods used to derive the values given in IRIS are provided in the Background Documents.

STATUS OF DATA FOR Asbestos

File First On-Line 09/26/1988

Category (section)	Status	Last Revised
Oral RfD Assessment (I.A.)	no data	
Inhalation RfC Assessment (I.B.)	no data	
Carcinogenicity Assessment (II.)	on-line	07/01/1993

_I. Chronic Health Hazard Assessments for Noncarcinogenic Effects

_I.A. Reference Dose for Chronic Oral Exposure (RfD)

Substance Name -- Asbestos
CASRN -- 1332-21-4

Not available at this time.

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_I.B. Reference Concentration for Chronic Inhalation Exposure (RfC)

Substance Name -- Asbestos
CASRN -- 1332-21-4

Not available at this time.

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_II. Carcinogenicity Assessment for Lifetime Exposure

Substance Name -- Asbestos
CASRN -- 1332-21-4

Sincock (1977) reported an increased number of chromosomes and chromosome breaks after passive inclusion of asbestos with CHO-K1 cells. Chamberlain and Tarmy (1977) reported asbestos not to be mutagenic for E. coli or S. typhimurium. A positive response was unlikely, however, since prokaryotic cells do not phagocytize particles as do eukaryotic cells.

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_II.B. Quantitative Estimate of Carcinogenic Risk from Oral Exposure

Not available.

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_II.C. Quantitative Estimate of Carcinogenic Risk from Inhalation Exposure

__II.C.1. Summary of Risk Estimates

Inhalation Unit Risk -- 2.3E-1 per (f/mL)

Extrapolation Method -- Additive risk of lung cancer and mesothelioma, using relative risk model for lung cancer and absolute risk model for mesothelioma

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	4E-4 f/mL = 0.0004 f/mL
E-5 (1 in 100,000)	4E-5 f/mL = 0.00004 f/mL
E-6 (1 in 1,000,000)	4E-6 f/mL = 0.000004 f/mL

__II.C.2. Dose-Response Data for Carcinogenicity, Inhalation Exposure

THIS DATA CURRENT AS OF THE FEDERAL REGISTER DATED FEBRUARY 6, 2002

40 CFR - CHAPTER I - PART 763

View Part

Appendix A to Subpart E -- Interim Transmission Electron Microscopy Analytical Methods -- Mandatory and Nonmandatory -- and Mandatory Section to Determine Completion of Response Actions

I. Introduction

The following appendix contains three units. The first unit is the mandatory transmission electron microscopy (TEM) method which all laboratories must follow; it is the minimum requirement for analysis of air samples for asbestos by TEM. The mandatory method contains the essential elements of the TEM method. The second unit contains the complete non-mandatory method. The non-mandatory method supplements the mandatory method by including additional steps to improve the analysis. EPA recommends that the non-mandatory method be employed for analyzing air filters; however, the laboratory may choose to employ the mandatory method. The non-mandatory method contains the same minimum requirements as are outlined in the mandatory method. Hence, laboratories may choose either of the two methods for analyzing air samples by TEM.

The final unit of this Appendix A to subpart E defines the steps which must be taken to determine completion of response actions. This unit is mandatory.

II. Mandatory Transmission Electron Microscopy Method

A. Definitions of Terms

1. *Analytical sensitivity* -- Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 structures/cm 3.

2. *Asbestiform* -- A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. *Aspect ratio* -- A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. *Bundle* -- A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. *Clean area* -- A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm 2 in an area of 0.057 mm 2 (nominally 10 200-mesh grid

12. Ensure that the mechanical vibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

13. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by damping out any pump action fluctuations if necessary.

14. The final plastic barrier around the abatement area remains in place for the sampling period.

15. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust. (See suggested protocol in Unit III.B.7.d.)

16. Select an appropriate flow rate equal to or greater than 1 liter per minute (L/min) or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

17. A minimum of 13 samples are to be collected for each testing site consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 seconds and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each abatement area.

ii. At one of the ambient sites. (DO NOT leave the field blanks open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

18. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

7. Abatement area sampling.

a. Conduct final clearance sampling only after the primary containment barriers have been removed; the abatement area has been thoroughly dried; and, it has passed visual inspection tests by qualified personnel. (See Reference 1 of Unit III.L.)

b. Containment barriers over windows, doors, and air passageways must remain in place until the TEM clearance sampling and analysis is completed and results meet clearance test criteria. The final plastic barrier remains in place for the sampling period.

c. Select sampling sites in the abatement area on a random basis to provide unbiased and representative samples.

d. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust.

i. Equipment used in aggressive sampling such as a leaf blower and/or fan should be properly cleaned and decontaminated before use.

ii. Air filtration units shall remain on during the air monitoring period.

iii. Prior to air monitoring, floors, ceiling and walls shall be swept with the exhaust of a minimum one (1) horsepower leaf blower.

iv. Stationary fans are placed in locations which will not interfere with air monitoring equipment. Fan air is directed toward the ceiling. One fan shall be used for each 10,000 ft 3 of worksite.

v. Monitoring of an abatement work area with high-volume pumps and the use of circulating fans will require electrical power. Electrical outlets in the abatement area may be used if available. If no such outlets are available, the equipment must be supplied with electricity by the use of extension cords and strip plug units. All electrical power supply equipment of this type must be approved Underwriter Laboratory equipment that has not been modified. All wiring must be grounded. Ground fault interrupters should be used. Extreme care must be taken to clean up any residual water and ensure that electrical equipment does not become wet while operational.

vi. Low volume pumps may be carefully wrapped in 6-mil polyethylene to insulate the pump from the air. High volume pumps cannot be sealed in this manner since the heat of the motor may melt the plastic. The pump exhausts should be kept free.

vii. If recleaning is necessary, removal of this equipment from the work area must be handled with care. It is not possible to completely decontaminate the pump motor and parts since these areas cannot be wetted. To minimize any problems in this area, all equipment such as fans and pumps should be carefully wet wiped prior to removal from the abatement area. Wrapping and sealing low volume pumps in 6-mil polyethylene will provide easier decontamination of this equipment. Use of clean water and disposable wipes should be available for this purpose.

e. Pump flow rate equal to or greater than 1 L/min or less than 10 L/min may be used for 25 mm cassettes. The

f. Sample a volume of air sufficient to ensure the minimum quantitation limits. (See Table I of Unit III.B.5.j.)

8. Ambient sampling.

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Joel A. Miele Sr., P.E., Commissioner
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October 25, 2001

Dear Residents of Lower Manhattan:

Since September 11th, the U.S. Environmental Protection Agency (EPA), NYC Department of Environmental Protection (DEP), NYC Department of Health (DOH), and the Occupational Safety and Health Administration (OSHA), have been taking samples of the air, dust, water, river sediments and drinking water and analyzing them for the presence of pollutants. The samples are evaluated against a variety of benchmarks, standards and guidelines established to protect public health under various conditions. These agencies consider the amount of time a person is exposed to a particular pollutant and where—a school, workplace or home—in creating these criteria.

The following is a description of some of the benchmarks, standards and guidelines these agencies are using to evaluate environmental conditions in the aftermath of the World Trade Center disaster.

Asbestos in the Air / in Open Spaces

EPA is requiring the strictest protective standard under AHERA, the Asbestos Hazard Emergency Response Act, for asbestos in outdoor and indoor areas. (This standard is used to determine whether children may reenter a school building after asbestos has been removed or abated.) To be as protective as possible, EPA, together with NYCDEP and all the other health and environmental agencies, are requiring school reentry standards in tests around the World Trade Center site. NYCDEP, USEPA, and NYC Department of Sanitation worked to perform cleanups of all dust in **exterior** areas with HEPA vacuums and wetwashing. **NYCDEP and EPA have both conducted tests in exterior spaces and all exterior areas of Lower Manhattan that were closed passed their strict protective standards before being opened again to the public.**

Asbestos in Dust in Buildings

If a substance contains more than 1% asbestos, it is considered to be an "asbestos-containing material." There are Federal, State, and City regulations in place to ensure the proper handling and disposal of asbestos-containing material. If a substance contains 1% or less asbestos, these regulations do not apply.

EPA is using the 1% definition in evaluating exterior dust samples in the Lower Manhattan area near the World Trade Center. All affected landlords have been instructed to test dust samples within their buildings utilizing this standard. **Landlords were notified that they should not reopen any building until a competent professional had properly inspected their premise. If more than 1% asbestos was found and testing and cleaning was necessary, it had to be performed by certified personnel.**

Drinking Water

NYC DEP continuously tests drinking water every day for multiple parameters. After the World Trade Center disaster, DEP expanded the number of tests taken and the parameters of testing. EPA also conducted separate tests. **Before and after the event, New York City drinking water has met and continues to meet all Federal, State, and City standards. Testing at a heightened level is continuing.**

NYC Department of Health

The New York City Health Commissioner Neal L. Cohen, M.D. has reviewed the findings of the various testing agencies and issued the following statements to residents. He said "despite the smoky conditions in areas of lower Manhattan that are close to the World Trade Center site, test results from the ongoing monitoring of airborne contaminants indicate that the levels continue to be below the level of concern to public health. Nonetheless, while debris continues to be disturbed, and while flare-ups of smoke continue to permeate the downtown area, air-testing results will continue to be monitored, and appropriate health recommendations will be issued as necessary." Dr. Cohen added, "As work continues at the disaster site, the presence of dust and smoke odor in the downtown area has been of understandable concern to residents. **However, air monitoring by Federal, State and City agencies has indicated that the levels of particulate matter being detected are below the level of public health concern and do not pose long-term health risks to the general public."**

In addition to air monitoring activities, efforts are being made daily to suppress dust and smoke at the World Trade Center disaster site. Results of daily dust sampling conducted by the U.S. Environmental Protection Agency is available online at epa.gov. Factsheets detailing Health Department recommendations pertaining to air quality, asbestos, safely reoccupying homes and buildings, and worker safety are available online at nyc.gov/health. For more information about all Health Department activities, New Yorkers can call **(212) 227-5269.** For information about asbestos issues, you can consult our website at nyc.gov/dep or call the New York City Department of Environmental Protection at **(718) DEP-HELP** and ask to be referred to our asbestos staff.

Very truly yours,

Joel A. Miele Sr., P.E., Commissioner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Region VIII

MEMORANDUM DEC 20 2001

SUBJECT: Amphibole Mineral Fibers in Source Materials in Residential and Commercial Areas of Libby Pose an Imminent and Substantial Endangerment to Public Health

FROM: Christopher P. Weis, Ph.D., DABT.
Senior Toxicologist / Science Support Coordinator
Libby Asbestos Site

TO: Paul Peronard, On-Scene Coordinator
Libby Asbestos Site

I PURPOSE

This memorandum presents the rationale for determination of imminent and substantial endangerment to public health from asbestos contamination in various types of source materials at residential and commercial areas in and around the community of Libby, Montana. With this memorandum, I confirm and extend a similar conclusion derived in two previous memoranda from my office to you (dated May 10, 2000, and July 9, 2001).

II SUMMARY OF FINDINGS

1) Asbestos occurs in ore and processed vermiculite obtained from the Libby mine.

2) Asbestos fibers of the type that occur in vermiculite ore from the mine in Libby are hazardous to humans when inhaled.

3) Asbestos material fibers that are characteristic of those that occur in materials from the Libby mine are present in a variety of different source materials at residential and commercial locations in and around the community of Libby. Outdoor source materials include yard soil, garden soil, driveway material, and assorted mine waste materials, while indoor source materials include dust and vermiculite insulation.

4) Disturbance of asbestos-contaminated source materials by activities similar to those that are likely to be performed by area residents or workers can result in exposure to respirable asbestos fibers in air.

5) The concentrations of fibers in air generated by disturbance of source materials may exceed OSHA standards for acceptable occupational exposure, and estimated

excess cancer risks can exceed EPA's typical risk range (1E-04 to 1E-06) by an order of magnitude or more. There are several factors which suggest these risk estimates may be too low and that actual risks are even greater.

On this basis, I conclude that source materials such as soil and soil-like media, dust, and vermiculite insulation that contain friable asbestos minerals are a likely source of on-going release of hazardous fibers to indoor and/or outdoor air at multiple residences and commercial facilities in Libby. In light of clear biological evidence of human asbestos exposure in Libby and the associated increase in human risk, I recommend that EPA take appropriate steps to reduce or eliminate pathways of exposure to these source materials in order to protect area residents and workers.

III BACKGROUND

A large deposit of vermiculite was discovered on Zonolite Mountain in the Rainy Creek Mining District of Lincoln County, Montana, in 1916 by E.N. Alley. Alley formed the Zonolite Company and began commercial production of vermiculite in 1921. Another company, the Vermiculite and Asbestos Company (later known as the Universal Insulation Company), operated on the same deposits (BOM 1953). W.R. Grace purchased the mining operations in 1963 and greatly increased production of vermiculite until 1990 when mining and milling of vermiculite ceased.

Vermiculite ore bodies on Zonolite Mountain contain amphibole asbestos at concentrations ranging up to nearly 100% in selected areas (Grace). Although early exploration and mining efforts by the Zonolite Company focused upon the commercial viability of fibrous amphibole deposits found on Zonolite Mountain (DOI 1928), no commercial production of asbestos from the Libby mine is reported. During early vermiculite mining operations, airborne concentrations of asbestos fibers at the mine exceeded 100 fibers per cubic centimeter (f/cc) in several job classifications (Amandus et al. 1987a,b, & c). Historical airborne fiber concentrations in the residential area of Libby also exceeded the present occupational Permissible Exposure Level (PEL) of 0.1 f/cc established by OSHA (1994) (MRI 1982; Eschenbach deposition). This exposure limit is recognized as being associated with significant risk (3.4 additional asbestos-related cancers per 1000 individuals as per OSHA estimates) to workers, and risks to residents could be even higher.

Residual fiber contamination from the subject facilities continues to present potential exposure to workers, residents, and visitors at these facilities, but is presently being addressed under removal authorities provided in the Comprehensive Environmental Response Compensation and Liability Act Section 104 (CERCLA or Superfund). These actions by the U.S. Environmental Protection Agency Region 8 office in Denver, CO began on November 22, 1999 and continue today. The investigative team is working closely with Local, State, and other Federal Agencies to determine the nature and extent of mineral fiber contamination throughout Libby, and to take appropriate action to protect the health of current residents and workers.

IV ENDANGERMENT RATIONALE

The rationale for determination of imminent and substantial endangerment from asbestos-contaminated source materials in residential and commercial areas of Libby is five-fold:

1) Asbestos fibers occur in ore and processed vermiculite from the Libby mine site.

2) Asbestos fibers from the Libby mine site are hazardous to humans as evidenced by the occurrence of asbestos-related disease in area workers and residents. Workers exposed to asbestos fibers at the Libby mine site have been shown to experience clear and significant increases in the incidence of asbestos-related conditions, including asbestosis, lung cancer and mesothelioma. Asbestos-related lung diseases have also been observed in area residents with no direct occupational exposures, including family members of mine workers, and even in those with no known association with the vermiculite mining or processing;

3) Asbestos fibers can be detected in several types of source materials (yard soil, garden soil, driveway material, waste piles, indoor dust, vermiculite insulation) at multiple locations in and around the residential and commercial area of Libby. These contaminated materials constitute a potential source of asbestos exposure to area residents and workers;

4) Asbestos fibers in contaminated source materials may be released into air by a variety of activities similar to those that area residents or workers may engage in under normal living or working conditions. This demonstrates that a complete exposure pathway exists by which asbestos-contaminated source materials may cause inhalation exposure of area residents and workers;

5) The concentrations of asbestos fibers that occur in air following disturbance of source materials may reach levels of potential human health concern, as evidenced by a) exceedences of OSHA standards for the protection of workers following disturbance of vermiculite material, and b) exceedences of EPA's normal risk range (1E-04 to 1E-06) for acceptable lifetime excess cancer risks for exposed humans. Actual risks may be even greater than estimated.

Summaries of the evidence supporting each of these elements of rationale are presented below.

1. Asbestos occurs in ore and vermiculite from the Libby mine

In order to gain a reliable understanding of the mineralogical characteristics of asbestos material associated with the Libby mine, the United States Geological Survey (USGS) collected 30 samples of asbestos-enriched ore material from the mine (USGS, 2001). Analysis of multiple

asbestos fibers in these samples was performed by electron dispersive spectroscopy (EDS) and electron diffraction in order to determine the elemental composition and the associated mineralogical class. The results are shown in Figure 1. As seen, fibers obtained from the mine span a range of over-lapping mineral types, including actinolite, tremolite, winchite, and richterite, with lower amounts of magnesio-arfedsonite and edenite/ferro-edenite. For the purposes of this memo, fibers included in the group above are referred to as "Libby-class amphiboles .

2. Libby Asbestos Fibers Are Hazardous to Human Health (Hazard Assessment)

Evidence of the adverse effects from exposure to asbestos fibers associated with the vermiculite ore body on Zonolite Mountain is abundant. During the 1980s, MacDonald et al. (1986a,b), and Amandus et al. (1987a,b,c) conducted investigations of asbestos exposure, and the morbidity and mortality of workers involved in various aspects of vermiculite mining, milling and refining processes in Libby, MT. These investigations found that workers had significantly increased occurrence of asbestosis, lung cancer, mesothelioma, and asbestos-related pleural disease associated with exposure to the vermiculite. Additionally, increased asbestos-related lung abnormalities were found among workers at an expansion plant in Marysville, Ohio, that were exposed to vermiculite from the Libby mine, Lockey et al. (1984).

Since the cessation of vermiculite mining and processing operations in Libby, local physicians and nearby pulmonary specialists have continued to identify individuals suffering from asbestosis, lung cancer and mesothelioma as a result of exposure to asbestos mineral fibers. One board-certified pulmonologist has reportedly seen over 150 cases of asbestos-related disease from the Libby area (Whitehouse 2000). In addition to former mine workers, this physician reported striking findings of asbestos-related disease among household contacts of former workers and among area residents with no identifiable connection to the former mine or processing activities. Some of those area residents with asbestos-related disease and no connection to the mining operations were reportedly exposed to asbestos through activities such as playing in open piles of vermiculite ores and wastes near recreational parks, gardening in soil containing vermiculite, and contact with vermiculite insulation in the home. Reports by area physicians are supported by recent morbidity and mortality assessments of Libby residents conducted by the Agency for Toxic Substances and Disease Registry (ATSDR). A mortality study for Libby area residents from 1979 to 1998 found increased rates of asbestosis (40-60 times higher than the normal background rate for the United States) and mesothelioma (ATSDR 2000). Additionally, ATSDR, working in cooperation with USEPA Region 8, U.S. Public Health Service, the State of Montana, and Lincoln County, has performed an extensive exposure and medical testing program involving nearly 6000 individuals that worked or lived in Libby for at least six months prior to 1991. Preliminary analysis of the data indicate that the crude odds ratio for the occurrence of pleural abnormalities is significantly elevated for individuals who were workers at the mine, and also for a variety of other non-occupational exposure pathways involving contact with vermiculite. Individuals with multiple exposure pathways to vermiculite or mine materials had higher disease incidence that those with no known exposure. Asbestos-associated radiologic abnormalities, similar to those observed among medical testing participants

in Libby, have been shown in other populations to be associated with significant progression of disease, morbidity, and mortality (Miller 1983, Cookson 1986, Rosenstock 1991, Erlich 1992, Hillerdal 1997).

3. Asbestos Fibers Occur in Several Types of Source Material in Residential/Commercial Areas

For approximately 2 years, EPA has been collecting samples of asbestos material associated with former mining and milling in the Libby, MT environment. This has included collection numerous types of potential source materials (outdoor yard soil, garden soils, indoor dust, vermiculite insulation, various types of waste piles, etc) as well as numerous air samples. Examination and evaluation of soil-like materials and bulk insulation samples was performed using polarized light microscopy (PLM), while samples of dust were evaluated by transmission electron microscopy (TEM), as detailed in the *Sampling and Quality Assurance Project Plan (Revision 1) for Libby, MT* (USEPA 2000). Initial sample collection efforts (referred to as Phase 1) focused mainly on areas formerly associated with mining and processing operations (the export plant, the screening plant, Rainy Creek Road, etc.), but also included samples collected from the residential and commercial areas of Libby. The second round of sampling (referred to as Phase 2) focused primarily on asbestos levels in the residential setting, with special attention on the effect of disturbance of source materials on asbestos levels in air.

The following sections summarize available data on the range of concentration values of Libby-type asbestos in samples of potential source materials (e.g., yard soil, garden soil, waste piles, driveway material, indoor dust, vermiculite insulation, etc.) at numerous locations in residential and light commercial areas of Libby. The data presented do not include measurements from former mine-related sites (e.g., the export facility, the screening facility, or Rainy Creek Road). Also, data from schools are not included, since they are not likely to be a good model for residential and commercial structures, and separate regulations exist for dealing with asbestos in schools. All data utilized in the following sections were based on a query of the Libby database performed on December 12, 2001, and all of the data from this query are available upon request.

Soil-Like Media (Yard Soil, Garden Soil, Waste Piles, and Driveway Material)

As noted above, samples of soil and related soil-like materials were analyzed for asbestos by PLM. Garden soils were grouped differently that yard soils since some garden soils might be amended with vermiculite even when the yard soil is not contaminated. Each sample was classified into one of the following groups:

Non-Detect (ND)	Presence of asbestos could not be confirmed by PLM
Trace	Asbestos is present, but the amount is too low (less than about 1% asbestos by mass) to allow reliable quantification
Detect	Asbestos is present at a level (typically 1% by mass or higher) such that quantification by PLM is possible.

Summary statistics for individual samples, grouped by medium, are presented below:

Table 1: Summary Statistics for Soil Like Media (Grouped by Sample)

Source Medium	Total Number of Samples	Number of Samples With Result Specified			Range of Detects
		ND	Trace	Detect	
Yard Soil	832	610	200	2.6% 22	1%-5%
Garden Soil	183	96	80	3.8% 7	1%-5%
Waste Piles	12	1	1	10	1%-10%
Driveway material	137	118	18	0.7% 1	1%
All soil-like media	1164	825	299	3.4% 40	1%-10%

As these data demonstrate, asbestos is detectable by PLM in about 29% (339 out of 1164) of the samples of soil and soil-like media have been collected from residential and commercial areas of Libby. Summary statistics for the maximum value detected at each of the individual residences or commercial buildings investigated are shown below:

Table 2: Summary Statistics for Maximum Values Grouped by Location

Source Medium	Total Number of Locations	Number With Maximum Result Specified			Range of Max
		ND	Trace	Detect	
Yard Soil	258	139	106	13	1%-5%
Garden Soil	109	43	59	7	1%-5%
Waste Piles	3	1	0	2	8%-10%
Driveway	94	77	16	1	1%
Any of the above	263	101	141	21	1%-10%

As indicated in table 2, of the total homes and commercial properties investigated, about 62% (162 out of 263) have detectable levels of asbestos present in one or more samples of an outdoor soil-like medium.

These findings support the conclusion that multiple locations exist where asbestos levels in outdoor soil-like media may serve as an on-going source of human exposure. Moreover, it is important to recognize that the PLM method has a relatively high detection limit for asbestos, and a non-detect by PLM is not equal to proof the sample is not contaminated with asbestos. To the contrary, other microscopic techniques (e.g., scanning electron microscopy) have shown that some soil samples that are below the limit of detection by PLM do contain high levels of asbestos

fibers (see Weis 2000 for a scanning electron microscope image of asbestos fibers in a soil sample that was below the limit of detection by PLM, and Addison 1995). The EPA is working to develop scanning electron microscopy and other related methods for the analysis of fiber in soil, but the methods are not yet sufficiently refined to support quantitative estimates of fiber concentration.

Vermiculite Insulation

Samples of bulk vermiculite insulation were analyzed for asbestos by PLM, and each sample was classified into one of three groups, as described above. Detection frequencies and ranges of quantifiable concentrations in individual samples, grouped by medium, are summarized below:

Table 3: Summary Statistic for Samples of Vermiculite Insulation

Grouped by	Total Number	Number With Result Specified			Range of Detects
		ND	Trace	Detect	
Sample	82	22	53	7	1%-5%
Location	69	15	47	7	1%-5%

As seen, asbestos fibers are detectable in about 60 of 82 (73%) samples of all vermiculite insulation, and in about 54 out of 69 (78%) of all locations tested. Concentration values range from trace (<1%) up to 5% by mass.

Indoor Dust

Analysis of indoor dust samples collected from residential locations or commercial buildings was performed using TEM in accord with the methods and counting rules specified in ISO 10312. In this procedure, individual asbestos structures are observed, and their size, shape, and mineral category are recorded. Because of this, there are several alternative ways in which the concentration of asbestos in the dust may be expressed. For the purposes of this memo, emphasis is placed on the concentration of fibers that are equivalent to those that would be detected using phase contrast microscopy (PCM), since this is the traditional method for measurement of asbestos fibers in air, and current methods for estimating risk from asbestos in air are based on the PCM method of quantification. PCM fibers are equal to or longer than 5 um, have an aspect ratio of at least 3:1, and are thick enough to be detected by PCM (about 0.25 um in diameter). Fibers observed under TEM that have these attributes are referred to as PCM-equivalents (PCME). Although PCM can not distinguish between asbestos fibers and non-asbestos fibers, this distinction is possible with TEM, so the PCME values derived from TEM analysis may be based either on all fibers, or on asbestos fibers only. In this report, PCME estimates based on all fibers (asbestos plus non-asbestos) are referred to as PCME-all and estimates based on Libby-type amphibole asbestos fibers only are referred to as PCME-asb. Because concentrations based on PCME-all are likely to over-estimate asbestos fiber concentrations in exposure situations such

as the home where non-asbestos fibers are common, this value is not used in this memo and emphasis is placed on PCME-asb.

Detection frequencies and ranges of quantifiable concentrations in dust, grouped either by individual sample or by maximum at a property, are summarized below for both Phase 1 and Phase 2 samples: **Note the percent samples where asbestos was actually found in indoor dust**

Table 4: Summary Statistics for Indoor Dust Samples

Grouped by	Data Set (a)	Total Number	PCME-asb	
			Detection Freq.	Range of Detects (s/cm^2)
Sample	Phase 1	258	**11.6%** 30/258	20-22645
	Phase 2	3	**100%** 3/3	1011-3658
Property (max value)	Phase 1	108	**23%** 25/108	20-22645
	Phase 2	3	**100%** 3/3	1011-3658

(a) Results from the Phase 1 study are currently reported only as "binned fiber counts (i.e., the number of fibers within certain size classes), while in Phase 2, data were reported on the size (length, width) of each individual fiber. Thus, for Phase 1 data, PCME fibers are estimated by summing the number of fibers in size bins that overlap the definition of PCM fibers, while for Phase 2, the number of PCM equivalent fibers can be calculated directly.

As seen, PCME-asb fibers are detected in 33 out of 261 (13%) of the dust samples collected , and in at least one sample at 28 out of 111 (25%) of all residential and commercial locations sampled. This indicates that there are multiple locations around Libby that are likely to contain asbestos fibers in indoor dust, and that this dust may serve as an on-going source of potential exposure for residents.

4. Disturbance of Contaminated Source Materials Can Release Fibers to Air

Asbestos fibers in soil or dust are not inherently hazardous to humans if left undisturbed. However, most soils and dusts are subject to disturbance, either now or in the future, by many different types of activities that are common for residents.

Information on the potential for release to air from each type of source material is summarized below. In all cases, the concentration values in air reported below are averages based on samples that were above the limit of detection. Air samples were normally analyzed by TEM and by PCM.

Release from Waste Piles

No studies have been performed in the residential/commercial area of Libby to quantify the release of asbestos from piles of vermiculite or other related mine waste materials, but studies performed during Phase 1 and subsequent remedial activities at these locations clearly

This conclusion is strongly supported by the study of Addison (1995) who generated airborne dusts from a series of soils with varying levels of asbestos contaminations. The study concluded that ***"even the lowest bulk amphibole concentration tested (0.001%) was still capable of producing measurable airborne asbestos concentrations (greater than 0.01 fibers ml^{-1})"***

Release from Indoor Dust

In order to obtain information on the potential for human activities to cause elevated asbestos levels in indoor air, EPA planned and performed a study referred to as Phase 2. The design of this investigation is presented in the *Phase 2 Sampling and Quality Assurance Project Plan (Revision 0) For Libby, Montana* (USEPA 2001). In brief, personal air monitors were used to measure the concentration of asbestos fibers in the breathing zone of people engaged in a series of scenarios that involved routine and special activities in the home, and stationary air monitors were used to measure to concentration in the general vicinity of the activities. The first two scenarios investigated in Phase 2 involved routine residential behaviors, as follows:

Scenario 1: Routine household activities
Scenario 2: Active cleaning activities (dusting, sweeping, vacuuming, etc.)

Results are summarized below.

Note that when asbestos was found by the test method, it was often below 0.01 f/cc (which is the same as f/mL)

Note that asbestos was not even detected in many of the air samples, yet this is still a Superfund site

Table 6: Concentration of Asbestos in Air Associated with Household Activities

Scenario	Method	Type	Detection Frequency	Values for Detects (f/cc)	
				Mean	Range
1 (Routine activity)	PCM	Personal	6/9	0.007	0.001-0.014
		Stationary	19/20	0.006	0.002-0.012
	PCME-asb	Personal	2/5	0.035	0.023-0.048
		Stationary	4/10	0.009	0.0003-0.036
2 (Active cleaning)	PCM	Personal	37/46	0.112	0.014-1.017
		Stationary	22/31	0.021	0.007-0.068
	PCME-asb	Personal	6/26	0.010	0.004-0.013
		Stationary	3/17	0.008	0.007-0.010

As indicated above, routine residential activities (Scenario 1) resulted in a small increase in fibers in personal air compared to nearby stationary air monitors when measured by PCM, and a clearer increase when measured by TEM (PCME-asb). For Scenario 2 (active cleaning), a clear increase was observed by PCM, with a smaller increase for TEM (PCME-asb). These data indicate that routine human activities in the home are associated with inhalation exposure to