Response to Pennsylvania Department of Health Statements and Pennsylvania Department of Environmental Protection Questions

Clarification of Department of Health Letter

1 Naturally occurring asbestos (NOA) is present in specific geological formations found in Pennsylvania. These rock formations, such as ultramafic rock, and serpentine rock, can be either found deep in the ground or in rocks at the surface. The amount of asbestos typically present in this rock can range from less than 1% up to about 25%. Naturally occurring asbestos can be released into the environment from its bound form if the rock is broken, crushed, or frayed either by human activity or via natural weathering processes.

The Department of Health (DOH) has not provided evidence, to our knowledge, regarding the typical amount of asbestos present in rock formations throughout Pennsylvania or the type(s) of asbestos present therein. Aggregate products containing an average of more than 1% asbestos would be considered asbestos-containing materials (ACMs).

2 In outdoor rural areas nonadjacent to known asbestos sources, background levels of asbestos in the air are about 10 (fibers/m^3) or 0.00001 PCM fibers/mL.

The Agency for Toxic Substances and Disease Registry (ATSDR, 2001)[1] and Abelmann *et al*. (2015)[2] have discussed background concentrations of asbestos in the U.S. Neither ATSDR (2001) nor Abelmann *et al*. (2015) specified the source, type, or width of these background EMPs. Abelmann *et al*. (2015) focused on fibers ≥5 µm in length measured by either phase contrast microscopy (PCM), transmission electron microscopy (TEM), or scanning electron microscopy (SEM), while ATSDR (2001) reported all the data on background levels as measured by PCM.

ATSDR (2001) reviewed a number of studies and reported ambient outdoor asbestos concentrations in urban areas of the U.S. ranging from 0.000003 to 0.0003 PCM fibers per cubic centimeter (f/cc) (*i.e.*, fiber concentration measured using a phase contrast light optical method). ATSDR defines a particle visible under PCM as a fiber if it is ≥5 µm in length, with a length to width ratio of ≥3:1. ATSDR (2001) reported that ambient outdoor asbestos concentrations in rural areas of the U.S. range from 3×10^{-8} to 1×10^{-5} PCM f/cc.

Abelmann *et al*. (2015) aggregated data from 17 published and unpublished studies and datasets that included 2,058 samples (from urban, rural, or unspecified locations) collected throughout the U.S. between the 1960s and the 2000s. After adjusting for different analytical techniques, and including only fibers ≥5 µm in length, Abelmann *et al*. (2015) estimated an overall mean and median from all 2,058 samples of 0.00093 and 0.00022 f/cc, respectively.

[1] Agency for Toxic Substances and Disease Registry (ATSDR). 2001. "Toxicological Profile for Asbestos." 441p., September.
[2] Abelmann, A; Glynn, ME; Pierce, JS; Scott, PK; Serrano, S; Paustenbach, DJ. 2015. "Historical ambient airborne asbestos concentrations in the United States - An analysis of published and unpublished literature (1960s-2000s)." *Inhal. Toxicol.* 27(14):754-766. doi: 10.3109/08958378.2015.1118172.

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ATSDR (2001) and Abelmann *et al*. (2015) indicate that asbestos is ubiquitous in the environment in the U.S. and that all U.S. residents have experienced some level of exposure to asbestos. ATSDR (2001) estimated the general population's cumulative exposure to background asbestos levels over a 70-year lifetime, considering the ranges of typical indoor and outdoor exposures in both rural and urban areas of the U.S., to be 0.002-0.4 f/cc-year.[3] Using the more recent data from Abelmann *et al*. (2015), we estimate that cumulative lifetime exposure to background asbestos levels in urban and rural areas of the U.S. is at the lower end of this range (around 0.0651 f/cc-year). This is equivalent to inhaling nearly 500 million asbestos fibers in a year.[4] An individual's specific lifetime exposure to background asbestos levels would depend on the geology and mineralogy of the area(s) of the U.S. in which they have lived, as well as any industries operating in the area.

3 Due to the wearing down or disturbance of manufactured products, including insulation, automotive brakes and clutches, ceiling and floor tiles, drywall, roof shingles, and cement, typically found in more urban settings, levels found in cities can be as much as 10-fold higher.

It is true that manufactured products that contain or are made from asbestos likely contribute to the ambient background asbestos levels particularly observed in urban areas of the U.S., more so than NOA.

4 There are several published studies and reports that discuss non-occupational asbestos exposure and describe health issues associated with NOA, manufactured asbestos production facilities, and community health.

The characteristics of asbestos contained in manufactured products are different than those of NOA, and the health risks associated with manufactured products containing/made from asbestos and NOA also differ. Studies of NOA exposure are discussed below, in response to other DOH statements (*e.g*., Responses 5 through 11).

5 The most well-known studies concerning asbestos exposure and human health are associated with asbestos mining in Libby, Montana. The most extensive studies of occupationally exposed asbestos lung injury come from this town and surrounding communities.

While amphibole asbestos was found in the mines in Libby, the area was being mined for vermiculite, not asbestos. The concentration of asbestiform amphiboles in the raw vermiculite ore from the Libby mine was reported to be 21-27%, and the feed to the vermiculite processing plant was reported to be 3.5-6.4% (Montana State Board of Health, 1962).[5] The United States Geological Survey (USGS) reported that the asbestiform amphiboles found in the ore consisted of 84% winchite, 11% richterite, and 6% tremolite (Meeker *et al*., 2003).[6] These concentrations are all orders of magnitude higher than the California Air Resources Board (CARB) "Asbestos ATCM [Airborne Toxic Control Measure] for Surfacing

[3] An f/cc-year is the product of an exposure concentration (f/cc) and exposure duration (years). For example, if someone was exposed to asbestos continuously in ambient air at 0.001 f/cc for 70 years, their cumulative exposure to asbestos is 0.07 f/cc-years.

[4] A typical inhalation rate for the general population is 20 m^3/day, or 7,300 m^3/year, or 7,300,000,000 cc/year (1 m^3 = 1,000,000 cc) (US EPA, 1989). If a person were exposed to 0.0651 f/cc asbestos for 1 year (equivalent to a cumulative exposure of 0.0651 f/cc-years), they would inhale 475,230,000 fibers (*i.e*., 0.0651 fibers/cc × 7,300,000,000 cc/year).

US EPA. 1989. "Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part A) (Interim final)." Office of Emergency and Remedial Response. NTIS PB90-155581; EPA-540/1-89-002. 287p., December.

[5] Montana State Board of Health. 1962. "A Report of an Industrial Hygiene Study of the Zonolite Company of Libby, Montana." Division of Disease Control. Submitted to Zonolite Co. 5p., April 19.

[6] Meeker, GP; Bern, AM; Brownfield, IK; Lowers, HA; Sutley, SJ; Hoefen, TM; Vance, JS. 2003. "The composition and morphology of amphiboles from the Rainy Creek complex, near Libby, Montana." *Am. Mineralogist* 88(11-12):1955-1969. doi: 10.2138/am-2003-11-1239.

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Applications" (17 CCR § 93106, adopted in 1990) (CARB, 1990),[7] which limits the asbestos content of material used for unpaved surfacing to less than 0.25% (with certain exemptions). Tailings from these mines were distributed and used all over the town of Libby, for decades, with no exposure controls, resulting in exposures to community members (Peacock, 2003).[8]

There are many other studies of the health effects of asbestos that include mining crocidolite and amosite in South Africa; chrysotile mining in the U.S., Canada, Russia, and elsewhere; insulation manufacturing; pipe manufacturing; brakelining and textile manufacturing and use in the U.S., Canada, U.K., and many other countries (Pierce *et al*., 2016).[9] Our knowledge of the health effects of asbestos is not restricted to the experience in Libby and the Libby experience may not be the most well-known worldwide.

6 A regionally relevant historical study is the Ambler, Pennsylvania, Ambient Air Study published in March 1977, which showed that asbestos fibers from an asbestos waste pile could be distributed by the wind to a neighboring community, but fiber concentrations in the air diminish rapidly as distance from source increases.

The former asbestos processing plant in Ambler, Pennsylvania, is now a 25-acre Superfund site (due to the presence of piles of asbestos-containing debris), called the Ambler Asbestos Piles Superfund Site (U.S. EPA Region III, 2017).[10] This site is very different from Rock Hill Quarry, which does not have any piles of asbestos or asbestos-containing materials that could be windblown. There are protocols and engineering controls that can be utilized at a mine or quarry to minimize exposure (as discussed in Section F of the NOA Resource Document).

The United States Environmental Protection Agency (U.S. EPA) had area air sampling performed for asbestos both at the Ambler Asbestos Piles Superfund Site and in the residential community near the site (PADEP, 1977).[11] Specifically, 73 filters were analyzed by PCM and TEM using a fiber length of >5 μm and an aspect ratio of ≥3:1 as the criteria for countable asbestos fibers. Only 4 filters out of the 73 detected asbestos (chrysotile), with a TEM concentration range of 0.017-0.085 f/cc. The average concentration as measured by PCM was 0.006 f/cc, with a range of 0.0005-0.066 f/cc.

For informational purposes, U.S. EPA also compared these air sampling data against the residential screening levels developed for the nearby BoRit Asbestos Superfund Site (also located in Ambler). These screening levels were based on the asbestos concentration used as a health-based benchmark for residential reoccupancy developed by U.S. EPA Region II and partner agencies in the wake of the September 11 World Trade Center disaster, and represents a theoretical excess cancer incidence of no more than 1 in 10,000 people exposed continuously to the benchmark value for 30 years. These screening levels were 0.001 PCM structures per cubic centimeter (s/cc, which encompasses structures including and in addition to fibers) for ambient air and 0.04 PCM s/cc for activity-based sampling (*i.e*., a sample for a set period of time for a specific exposure scenario such as a worker or trespasser). None of the on-site or off-site air samples collected for the Ambler Asbestos Piles Superfund Site in 2016 exceeded these screening levels (U.S. EPA Region III, 2017).

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[7] California Air Resources Board (CARB). 1990. "Section 93106 - Asbestos ATCM for Surfacing Applications." 17 CCR § 93106. Accessed at http://carules.elaws.us/code/t.17_d.3_ch.1_subch.7.5_sec.93106.

[8] Peacock, A. 2003. *Libby, Montana Asbestos & the Deadly Silence of an American Corporation*. Johnson Books, Boulder, Co.

[9] Pierce, JS; Ruestow, PS; Finley, BL. 2016. "An updated evaluation of reported no-observed adverse effect levels for chrysotile asbestos for lung cancer and mesothelioma." *Crit. Rev. Toxicol.* 46(7):561-586. doi: 10.3109/10408444.2016.1150960.

[10] U.S. EPA Region III. 2017. "Fifth Five-Year Review Report for Ambler Asbestos Piles Superfund Site, Montgomery County, Pennsylvania." 61p., June 26. Accessed at https://semspub.epa.gov/work/03/2246033.pdf.

[11] Pennsylvania Department of Environmental Protection (PADEP). 1977. "The Results of an Ambient Air Asbestos Monitoring Program in the Vicinity of an Inactive Refuse Pile in Ambler, Pennsylvania (July 1977 Sampling Survey)." Report prepared by Equitable Environmental Health, Inc. for the Pennsylvania Department of Environmental Protection (PADEP), October.

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7 A follow-up study was conducted in the same [Ambler, PA] community between 2008 and 2011. Although mesothelioma levels were higher in the affected community, only samples collected on the national priority list site exceeded EPA screening values.

While there was an increase in mesothelioma cases in the Ambler community in this time period, the follow-up study concluded that these cases were most likely associated with occupational exposures to asbestos (*e.g.*, from working in the ship building or manufacturing industries [for products that contain asbestos]) and not community exposures to ambient asbestos (U.S. EPA Region III, 2017; PADOH, 2011).[12]

8 Several asbestos-related lung disease cases were observed to be higher in communities surrounding a large defunct asbestos mining operation near Belvedere Mountain, Vermont, as compared to control communities. However, as published in the document *A Cross-Sectional Study of Asbestos-Related Morbidity and Mortality in Vermonters Residing Near an Asbestos Mine,* VDOH 2008, and the follow-up report published in 2009, upon further investigation many of the previously reported asbestos-associated illnesses were determined to be occupationally related.

A health study in communities (Eden and Lowell, Vermont) surrounding a large defunct chrysotile asbestos mining operation near Belvidere Mountain, Vermont, was conducted in 2008 (VTDOH, 2008)[13] and a follow-up study was conducted in 2009 (VTDOH, 2009).[14] The Vermont Department of Health (VTDOH) stated:

> The significant finding of this supplemental study is that **all** [emphasis added] of the five asbestosis-related deaths that occurred in towns surrounding the mine during the years 1996 to 2005 can be explained by occupational exposure to asbestos. With this additional study, the Vermont Department of Health found no evidence that people who live near the mine are more likely to die of non-occupationally contracted asbestos-related diseases than people who live elsewhere in the state. (VTDOH, 2009)

It should be noted that the communities involved in this study were located near a large asbestos mine and mill (VTDOH, 2009). This highly contaminated asbestos mine site is not comparable to a rock quarry.

[12] Pennsylvania Dept. of Health (PADOH). 2011. "Cancer Evaluation - Ambler Area, Montgomery County." 4p., July. Accessed at https://www.med.upenn.edu/asbestos/assets/user-content/documents/Cancer_Evaluation_July_2011.pdf.
[13] Vermont Dept. of Health (VTDOH). 2008. "A Cross-Sectional Study of Asbestos-Related Morbidity and Mortality in Vermonters Residing Near an Asbestos Mine." 12p., December 9. Accessed at https://www.healthvermont.gov/sites/default/files/documents/2016/12/RESP_VAG_Mine_Report_12_09_2008.pdf.
[14] Vermont Dept. of Health (VTDOH). 2009. "Case Series Follow-up to 'A Cross-Sectional Study on Morbidity & Mortality Among Vermonters Near an Asbestos Mine.'" April 1. Accessed at https://www.healthvermont.gov/sites/default/files/documents/2016/12/RESP_VAG_CaseSeriesReport_04_01_2009.pdf

9 In western states, NOA exposure risks have been gaining public interest and concern. Two case studies titled: *The presence of asbestos in the natural environment is likely related to mesothelioma in young individuals and women from Southern Nevada,* Bauman et al. 2015, and the El Dorado Hills, California (*Naturally Occurring Asbestos Multimedia Exposure Assessment El Dorado Hills, California (EPA))* documents present a different hazard to a non-traditional population of citizens.

There are many differences between the geology, climate, wind direction and speed, topography, vegetation, and other environmental conditions of both Nevada and California and those of Pennsylvania, indicating these areas are not appropriate comparisons to Pennsylvania.

Notably, Bauman *et al*. (2015)[15] did not actually provide evidence for an increased mesothelioma risk in the cohort of Southern Nevada residents they studied, as they relied on sex ratios to assess risk. As noted by Pinheiro and Jin (2015),[16] from the University of Nevada Las Vegas, "the methodology used was inappropriate" because they used an improper indicator of risk in a population. The investigators found no evidence for an increased incidence of mesothelioma in Southern Nevada compared to the U.S. as a whole.

With respect to El Dorado Hills, California, ATSDR (2011)[17] concluded:

> Reducing exposures to NOA will protect people's health and is warranted in El Dorado County based on estimates of past exposures. State cancer registry information indicates that the community's health has not been impacted at this time. However, health impacts to individuals from past exposures are highly variable and may take years before the cancer registry detects them.

That is, as of 2011, 50 years after the community of El Dorado Hills was first established, there was no evidence for an association between NOA exposure and health effects. Furthermore, an independent reviewer, R. J. Lee Group, reanalyzed the soil samples collected at schools in El Dorado County that had originally been analyzed by U.S. EPA's contract laboratory (Lab Cor) and did not find asbestos in the samples. Most of the amphibole mineral found on the schools' grounds was actually hornblende (RJ Lee Group, Inc., 2005).[18] This finding was reviewed by Drs. Malcom Ross, Art Langer, and Ann Wylie, all of whom agreed with R. J. Lee Group's conclusions.[19,20,21]

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[15] Bauman, F; Buck, BJ; Metcalf, RV; McLaurin, BT; Merkler, DJ; Carbone, M. 2015. "The presence of asbestos in the natural environment is likely related to mesothelioma in young individuals and women from Southern Nevada." *J. Thorac. Oncol.* 10:373-377.

[16] Pinheiro, PS; Jin, H. 2015. "No increased risk for mesothelioma in relation to natural-occurring asbestos in southern Nevada (Letter)." *J. Thorac. Oncol.* 10(7):e62-e63. doi: 10.1097/JTO.0000000000000564.

[17] Agency for Toxic Substances and Disease Registry (ATSDR). 2011. "Technical Information Sheet – ATSDR Evaluation of Community-Wide Exposure to Naturally Occurring Asbestos." Division of Health Assessment and Consultation. Accessed at https://www.atsdr.cdc.gov/hac/pha/eldoradohills/techinfosheetrev72011508.pdf.

[18] RJ Lee Group, Inc. 2005. "Final Evaluation of EPA's Analytical Data from the El Dorado Hills Asbestos Evaluation Project." Report to National Stone, Sand & Gravel Association. 79p., November.

[19] Langer, AM. 2005. Letter to W. Ford (National Stone, Sand & Gravel Association) re: R. J. Lee Group (RJLG)'s critique of EPA's El Dorado Hills, Naturally Occurring Asbestos Multimedia Exposure Assessment and Site Inspection Report Interim Final (EPA-EDH) study. 3p., December 14.

[20] Wylie, A. 2005. Letter to National Stone, Sand & Gravel Association re: Review of the November 2005 report prepared by RJ Lee Group entitled "Evaluation of EPA's Analytical Data from the El Dorado Hills Asbestos Evaluation Project." 2p.

[21] Ross, M. 2005. "Review of the RJ Lee Report titled 'Evaluation of EPA's Analytical data from the El Dorado Hills Evaluation Project' prepared for the National Stone, Sand & Gravel Association, 1605 King Street, Alexandria, VA 22134." 3p.

10 These studies document that environmental exposure to NOA can occur in communities near specific geological formations and may increase risk of asbestos-related lung diseases. The risk is highly dependent on climate (dry), weather patterns and activity, e.g., dust storms, type of regional geology, and type of human activities conducted in high NOA areas.

If asbestos in a quarry is released into the air, and air concentrations of asbestos at the quarry's property line are both statistically above those found before mining began and above the concentration associated with adverse health effects, mining of that quarry should not be permitted to continue until additional controls are installed and their effectiveness tested. However, we are not aware of any studies that provide evidence for an increased risk of adverse health effects associated with exposure to NOA in communities where there have not been other sources of potential asbestos exposure (such as an asbestos processing plant or storage facility).

11 As with the defunct, inactive Ambler, Pennsylvania, and Belvedere mountain sites, activity at these sites was prohibited.

To reiterate, the Ambler site was disposal site for asbestos from asbestos-product manufacturing companies and Belvedere Mountain was an asbestos mining site (see Responses 6 and 8 above). The fact that activity was prohibited at these sites does not indicate that there were risks of exposure to the community – the sites were shut down as a result of health effects experienced by workers at the sites, rather than community members (U.S. EPA Region III, 2017; PADOH, 2011; VTDOH, 2008, 2009). Furthermore, these Superfund sites are not comparable to an aggregate quarry such as the Rock Hill Quarry.

12 However, recreational activities such as off-road vehicle sports and mountain bicycle riding in areas with high levels of NOA can lead to increased levels of airborne dust, which results in higher rates of inhaled asbestos fibers.

It is not clear how recreational activities pertain to activities that take place in or at an aggregate quarry such as the Rock Hill Quarry. In addition, dust mitigation strategies can reduce the amount of airborne dust generated by the specific activities and processes that take place at quarries or other types of mining operations (see Section F of the NOA Resource Document).

13 There are no current federal standards that limit the concentration of asbestos in ambient air in the US. Rather, federal regulations set forth restrictions on (1) emission levels from known point sources, (2) the manufacture, importation, processing, and distribution of certain asbestos-containing products and ''new uses'' of asbestos, and (3) the use and handling of asbestos-containing material during construction, demolition and renovation.

Notably, there are federal standards regulating the amount of asbestos in air in occupational settings, such as those issued by the Occupational Safety and Health Administration (OSHA) for exposure to asbestos while working in general industry (29 CFR 1910.1001; OSHA, 2019)[22] and construction (29 CFR 1926.1101; OSHA, 1995).[23] These values only apply to workers, rather than communities or other individuals located nearby construction, demolition, or other industry activities involving asbestos. These regulations are described further in Section F of the NOA Resource Document.

[22] Occupational Safety and Health Administration (OSHA). 2019. "Occupational Safety and Health Standards: Subpart Z – Toxic and Hazardous Substances: Asbestos." 29 CFR 1910.1001.

[23] Occupational Safety and Health Administration (OSHA). 1995. "Safety and Health Regulations for Construction: Subpart Z - Toxic and Hazardous Substances: Asbestos." 29 CFR 1926.1101.

Federal restrictions on levels of asbestos emissions from known point sources include the National Primary Drinking Water Regulations (NPDWR) Maximum Contaminant Level (MCL) of 7 million fibers >10 μm in length per liter of drinking water (U.S. EPA, 2020)[24] (as discussed further in Sections C and G of the NOA Resource Document).

In addition to applicable federal regulations (as discussed further in Section F of the NOA Resource Document), some state agencies have also restricted levels of asbestos in air for specific sites. For instance, certain sites have Pennsylvania Department of Environmental Protection (DEP)-approved limitations included in the site's operating permit. In the operating permit for a quarry and processing plant in Adams County, Pennsylvania (RJ Lee Group, 2020),[25] there is a 0.01 f/cc limit for airborne asbestos at the site. The analytical method to be used for the air samples at this site follows the Asbestos Hazard Emergency Response Act (AHERA) method, with a modified aspect ratio criterion being reduced from a minimum of 5:1 to 3:1 (U.S. EPA, 2008).[26] The AHERA analytical procedure is designed to determine how clean a space is following asbestos removal in buildings (U.S. EPA, 1987).[27] This level has no relevance to asbestos-related quantitative risk estimates.

14 Although state or federal regulations for asbestos in ambient air are rare, due to a historical relationship with asbestos mining, the state of Vermont has set a Stationary Source Hazardous Air Impact Standard for asbestos fibers (Annual Average) at 0.00012 μg/m³.

Asbestos concentrations in air are typically measured in units of f/cc, not mass (μg/m^3) (see Section C of the NOA Resource Document for more information). Studies of asbestos-associated health effects also assess risks from asbestos exposure using levels of asbestos measured in units of f/cc (see Section B in the NOA Resource Document). We know of no U.S. studies specifically linking mass measurement concentrations of asbestos to health risks. It is unclear why Vermont has set an air impact standard for asbestos in units of mass, and without an equivalent value in units of f/cc.

15 As it pertains to the health of citizens who live near the Rock Hill Quarry, NOA is best to be avoided and left alone. Natural weathering and erosion may increase the risk of exposure to neighboring communities in drier months. Any mechanized activity or kinetic energy that makes physical contact with geological formations that contain asbestos, asbestos-like material, or elongated mineral fibers will accelerate the natural weathering process.

We are not aware of any evidence that workers at or the community near Rock Hill Quarry would experience hazardous NOA exposures if proper precautions are taken at the quarry, such as worker safety precautions (*e.g.*, personal protective equipment and monitoring of workplaces), environmental dust controls, and general site safety practices (*e.g.*, access limitations, protective barriers, fencing, or surface covers and environmental monitoring) (see Section F of the NOA Resource Document for more information on these precautions). Assuming that the proper precautions are taken at the Rock Hill Quarry, as

[24] U.S. EPA. 2020. "National Primary Drinking Water Regulations." February 14. Accessed at https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations#four.
[25] RJ Lee Group. 2020. "Asbestos Monitoring and Mitigation Plan at Specialty Granules LLC." Report to Specialty Granules LLC. 19p., June 16. Accessed at http://files.dep.state.pa.us/RegionalResources/SCRO/SCROPortalFiles/Community%20Info/SpecialtyGranulesQuarry/01180301/SMPandNPDESPermits/Asbestos%20Monitoring%20and%20Mitigation%20Plan.pdf.
[26] US EPA. 2008. "Framework for Investigating Asbestos-Contaminated Superfund Sites." Office of Solid Waste and Emergency Response (OSWER). OSWER Directive 9200.0-68. 71p., September. Accessed at http://www.epa.gov/superfund/health/contaminants/asbestos/pdfs/framework_asbestos_guidance.pdf.
[27] U.S. EPA. 1987. "Asbestos-Containing Materials in Schools (Final Rule)." *Fed. Reg.* 52(210):41826-41905. 40 CFR Part 763, October 30.

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described above and in the NOA Resource Document, any airborne asbestos levels that travel beyond the Rock Hill Quarry property are unlikely to be higher than background levels.

16 There are varying levels of agreement between the PADEP, Rockhill Environmental Preservation Alliance (REPA) and Pierson Materials/Hanson Aggregates concerning the amount or type of respiratory elongated mineral fibers (EMF) present. However, environmental, geological sampling commissioned by the aforementioned entities, have agreed that actinolite, a type of asbestos fiber, is present in the rock material at the Rock Hill Quarry site. Analytical reports also agree that "non-asbestos" mineral material in exceedance of 3:1 length to width ratio is also present in the geological materials sampled and analyzed from the site. Both of these observations justify pause for further evaluation.

While there is actinolite in the mineral veining in the diabase host rock at the Rock Hill Quarry, it occurs in both asbestos and non-asbestos forms. Evidence to date suggests that there is no risk of asbestos-associated health effects from exposure to the non-asbestos forms of the asbestos minerals (as discussed further in Section B of the NOA Resource Document); this would apply to the non-asbestos form of actinolite.

In addition, the presence of NOA in rock does not necessarily mean anyone will be exposed to that NOA, or that NOA exposures would constitute a health risk. Engineering controls should be in place during mining activities to minimize any such exposures, and air should be monitored during mining activities to confirm exposures are minimized (as discussed further in Section F of the NOA Resource Document).

17 Free asbestos fibers of a length greater than 5 µM, with an aspect ratio greater than 3:1, are the most hazardous due to increased lung penetration and deposition. These fibers can cross blood vessels and, if consumed, gastrointestinal walls. Asbestos mineral fibers of these dimensions are difficult for the body to remove and, depending on the site of deposition, can cause scarring and oxidative stress.

Fibers with a diameter greater than 3 µM have not been observed to be respirable and have been observed to be less hazardous. Some types of asbestos fibers, such as chrysotile, can split into fibrils and undergo partial dissolution within the lungs. This breakdown into smaller pieces can lead to increased pulmonary clearance.

The health risks of EMPs of various lengths, widths, and aspect ratios are discussed in Section B of the NOA Resource Document.

18 Amphibole asbestos such as actinolite do not subdivide into fibrils of smaller diameter or break up by length. They are much less soluble in lung fluids, and they have long residence times in the lungs.

Also, the risk of lung disease associated with environmentally exposed asbestos depends on several factors. The most important of these are (1) how long you were exposed, (2) how long it has been since your exposure started, and (3) whether you smoked cigarettes. Cigarette smoking synergistically interacts with asbestos exposure and will increase your chances of developing lung cancer.

The physicochemical characteristics and health risks of amphibole asbestos are discussed in Section B of the NOA Resource Document. All forms of asbestos, including actinolite asbestos, can subdivide

into fibrils (Coffin *et al*., 1982).[28] As discussed in Section A of the NOA Resource document, this is one of the defining characteristics of all asbestos fibers.

Smokers who are exposed to high levels of asbestos have a greater risk of lung cancer than the independent risks from asbestos and smoking added together (NCI, 2017),[29] but little attention has been paid to whether there is an interaction between smoking and asbestos at low asbestos exposure levels. Regardless, it is clear that for a smoker's lung cancer to be at least partially attributable to asbestos, there must be sufficient cumulative exposure to asbestos or the presence of asbestosis (indicating high levels of asbestos exposure) (Liddell and Armstrong, 2002; Cagle, 2002).[30,31]

19 Although the presence of these types of minerals have been associated with illness and injury in medical reports, and environmental investigations, the Department does not currently have sufficient data to support the assessment that communities or children who attend schools in close proximity to the Rock Hill Quarry are in immediate risk of asbestos or EMP-related illness.

As discussed in Section B of the NOA Resource Document, health effects have been associated with high exposures to some, but not all, EMPs. There is no specific evidence regarding whether airborne asbestos fibers from NOA would travel beyond the Rock Hill Quarry's property line, but based on studies of areas with much higher potential for airborne asbestiform EMPs (such as the Ambler Asbestos Piles Superfund Site; see Response 6 above), it is most likely that the concentration of airborne asbestiform EMPs that would travel beyond the quarry property line would be very low, provided the quarry operators take appropriate precautions (see Response 15 above).

20 There is also a paucity of data available to evaluate whether current or proposed activities on the Rock Hill Quarry site are protective of the health of workers on site, adults and children who live near the Rock Hill Quarry, and children who attend school near the site. To address these gaps in knowledge, additional environmental sampling should be conducted. Comprehensive health-based environmental sampling should at least include air and soil sampling for onsite, source, property/fence line, and offsite locations. To produce sample data most applicable to human health, stationary breathing zone and on-person sampling methods should be employed over several weeks, including summer and winter seasons covering various weather conditions. Also, various activity-based personal sampling should be considered.

We agree that air sampling should occur during mining activities (see Section F of the NOA Resource Document). We also confirm that, to date, we have not found any evidence regarding asbestos-related health risks to children who attend school near the Rock Hill Quarry site or adults and children who live near the site.

[28] Coffin, DL; Palekar, LD; Cook, PM. 1982. "Tumorigenesis by a ferroactinolite mineral." *Toxicol. Lett.* 13(3-4):143-149. doi: 10.1016/0378-4274(82)90202-8.

[29] National Cancer Institute (NCI). 2017. "Asbestos Exposure and Cancer Risk." June 7. Accessed at https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/asbestos/asbestos-fact-sheet.

[30] Liddell, FD; Armstrong, BG. 2002. "The combination of effects on lung cancer of cigarette smoking and exposure in Quebec chrysotile miners and millers." *Ann. Occup. Hyg.* 46(1):5-13.

[31] Cagle, PT. 2002. "Criteria for attributing lung cancer to asbestos exposure." *Am. J. Clin. Pathol*. 117(1):9-15.

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21 To determine the risk of exposure to vulnerable populations, a thorough environmental asbestos sampling plan should also include schools, daycares, and hospitals, etc.

We believe that sampling at the perimeter of the quarry would be the most effective way to assess risks to the general population. The benefits of environmental sampling for asbestos in the vicinity of the Rock Hill Quarry that specifically includes schools, day care facilities, and hospitals are not clear, as there is no evidence that asbestos from the quarry would reach any such facilities in the nearby community. In addition, were any levels of airborne asbestos detected at these facilities, it would be difficult, if not impossible, to confirm whether the detected fibers are attributable to asbestos emissions from the Rock Hill Quarry (*e.g.*, they could be background levels).

22 If evidence of substantial water runoff has been detected, waterbody sampling should be included (river, lake, pond) in the sampling plan, especially if the runoff leaves the site. As an example, the EPA has executed several comprehensive NOA environmental sampling studies involving nearly 400 air samples and 180 soil samples in a Californian community and neighborhood school. The methods and results are presented in the EPA document titled: *El Dorado Hills Naturally Occurring Asbestos Multimedia Exposure Assessment El Dorado Hills, California.* In another NOA EPA document titled Environmental Monitoring for Asbestos: Sumas Mountain Asbestos Site Selected Residential Properties, bulk, activity-based and surface water sampling methods are explained in detail.

The Sumas Mountain Asbestos Site is a Superfund site involving a continuing landslide of a mountain that has contributed very high concentrations of naturally occurring chrysotile asbestos to a nearby creek (Ecology and Environment, Inc., 2013).[32] Asbestos concentrations were over 26% in some river and stream sediments (Ecology and Environment, Inc., 2013). Moreover, the Washington Department of Health (WADOH) found no indication that NOA from the site contributed to an increase of asbestos-related health effects in the potentially exposed population (WADOH, 2013).[33]

Because the primary concern for health effects caused by asbestos exposure is from the inhalation of asbestos fibers (as discussed in Section B of the NOA Resource Document), the benefits of sampling water bodies for asbestos levels are not clear. We are not aware of this being a DEP requirement for any other quarries in Pennsylvania.

32 Until sufficient data are available to determine the level of onsite and offsite asbestos or hazardous EMP exposure during various activities over more than one season, the risk of asbestos-related illness in the stakeholder population will not be fully understood. As environmental investigations continue at the Rock Hill Quarry site, material containing NOA should be addressed with concern.

Background samples both downwind and upwind of the quarry should be collected and analyzed before and after the quarry production begins. As discussed in Response 15 above, if the proper precautions are taken at the Rock Hill Quarry, such as various worker safety precautions, environmental dust controls, and general site safety practices (as discussed further in Section F of the NOA Resource Document), no one is expected to be exposed to hazardous levels of asbestos or other EMPs at or in the vicinity of the quarry.

[32] Ecology and Environment, Inc. 2013. "Draft Engineering Evaluations / Cost Analysis, Sumas Mountain Asbestos (aka Swift Creek) Site, Whatcom County, Washington." Report to U.S. EPA Region X. 200p., July.

[33] Washington State Dept. of Health (WADOH). 2013. "Sumas Mountain/Swift Creek Asbestos Cluster Investigation." Environmental Epidemiology, Division of Environmental Public Health, May.

33 Generally, there are three concepts to consider when NOA has been identified at a location.

If possible, NOA should be avoided and left alone: If rock containing NOA is intact and undisturbed, your risk of exposure is low. Avoid blasting it, crushing it, or grinding it up. If possible, prohibit access or limit activities in the area.

Especially avoid digging transporting and or gardening in areas in which NOA has been detected or suspected to be present. Avoid riding bicycles on unpaved surfaces. Avoid riding off-road vehicles such as four-wheelers and dirt bikes in areas with NOA. Also, limit running, hiking, or driving on unpaved surfaces in these areas. If activities in the area determined to have NOA cannot be avoided, then risk minimization procedures should be considered.

1. **Have a plan. Before you disturb rock or soil that is likely to contain asbestos, make sure you have an adequate protocol in place to control and contain the dust. If the enterprise is large and it is anticipated that a large amount of dust may be generated, consider notifying surrounding communities to avoid being outside or downwind of the site of concern prior to the event. Also, partnering with local and state air monitoring teams to determine the NOA fiber levels offsite would be appropriate.**
2. **Keep it wet and cap it: If the rock or dirt contains NOA, keep it wet while you're working, and seal it under a layer of clean soil and a layer of pavement, turf, or clean gravel.**
3. **Also, the risk of lung disease associated with environmentally exposed asbestos depends on several factors. The most important of these are (1) how long you were exposed, (2) how long it has been since your exposure started, and (3) whether you smoked cigarettes. Cigarette smoking synergistically interacts with asbestos exposure and will increase your chances of developing lung cancer.**

While there is currently no evidence that residents living near the Rock Hill Quarry have been exposed to airborne asbestos from NOA at the quarry, there will be procedures in place at the quarry to minimize dust generation and travel, minimize workers' asbestos exposure, and ensure that people who are in the vicinity of the site when the quarry is active are not exposed to asbestos from NOA at the quarry. Levels of airborne asbestos will be monitored on a regular basis.

As discussed in Section B of the NOA Resource Document, an individual's asbestos dose is an equally important factor in determining their risk of developing asbestos-related diseases. As also discussed therein, there is increasing evidence that a threshold level of asbestos exposure exists below which there will be no increased risk of developing known asbestos-related disease. Similarly, it is highly unlikely that sufficiently low levels of asbestos exposure (*e.g.*, background levels) can increase lung cancer risk, even in smokers (Liddell and Armstrong, 2002; Cagle, 2002).

PADEP Questions to PADOH

1. Is there a level, amount, or exposure limit to asbestos that is considered normal because of its former presence in everyday products?

Recently, Abelmann *et al.* (2015)[34] reported an overall mean asbestos concentration of 0.00093 f/cc (detected range = 0.000048-0.05 f/cc) and a median concentration of 0.00022 f/cc for 2,058 samples of air collected in urban, rural, and unspecified locations throughout the U.S.

2. Is there a level or percent of asbestos contamination in everyday products such as wallboard or other construction materials that is allowed/accepted?

Most uses of asbestos in products are entirely prohibited under federal law (U.S. EPA, 1989).[35] OSHA (2018, p. 19)[36] defines an asbestos-containing material (ACM) as "any material containing more than 1% asbestos," and any ACM with an asbestos content of ≥1% is subject to labeling requirements.

In addition, the CARB "Asbestos ATCM for Surfacing Applications" (17 CCR § 93106, adopted in 1990) (CARB, 1990)[37] limits the asbestos content of material used for unpaved surfacing to less than 0.25% (although certain exemptions to this limit exist).

3. Does the DOH have recommendations for air quality limits for the mine workers and for concentrations of asbestos leaving the site? Are there different standards for different receptors such as a school?

As discussed in Section F of the NOA Resource Document, for mine workers, the current OSHA and Mine Safety and Health Administration (MSHA) asbestos exposure limits apply. OSHA has set a Permissible Exposure Limit (PEL) of 0.1 f/cc as a time-weighted average (TWA) over an 8-hour work shift, as well as a PEL of 1.0 f/cc as a TWA over a 30-minute exposure (OSHA, 2018). MSHA sets its own PELs for the U.S. mining industry, both of which are the same as those set by OSHA (MSHA, 2008).[38]

Beyond occupational exposure limits (such as the OSHA and MSHA PELs), there are no federal regulatory asbestos exposure limits (*i.e.*, for the general U.S. population). However, as discussed in Section F of the NOA Resource Document), the National Institute for Occupational Safety and Health (NIOSH), a research agency operating as part of the Centers for Disease Control and Prevention (CDC), sets a non-regulatory

[34] Abelmann, A; Glynn, ME; Pierce, JS; Scott, PK; Serrano, S; Paustenbach, DJ. 2015. "Historical ambient airborne asbestos concentrations in the United States - An analysis of published and unpublished literature (1960s-2000s)." *Inhal. Toxicol.* 27(14):754-766. doi: 10.3109/08958378.2015.1118172.
[35] U.S. EPA. 1989. "Asbestos; Manufacture, importation, processing, and distribution in commerce prohibitions (Final rule)." *Fed. Reg.* 54:29459-29513. July 12.
[36] Occupational Safety and Health Administration (OSHA). 2018. "Occupational safety and health standards: Subpart Z - Toxic and hazardous substances: Asbestos." 29 CFR 1910.1001. 53p.
[37] California Air Resources Board (CARB). 1990. "Section 93106 - Asbestos ATCM for Surfacing Applications." 17 CCR § 93106. Accessed at http://carules.elaws.us/code/t.17_d.3_ch.1_subch.7.5_sec.93106.
[38] Mine Safety and Health Administration (MSHA). 2008. "Asbestos Exposure Limit; Final Rule." *Fed. Reg.* 73(41):11283-11304. 30 CFR 56, 57, 71, February 29.

Recommended Exposure Limit (REL) of 0.1 f/cc for the six asbestos minerals and their non-asbestiform analogs (NIOSH, 2011).[39]

Asbestos in U.S. schools is regulated under the U.S. EPA Asbestos Hazard Emergency Response Act (AHERA) (U.S. Congress, 2011),[40] which, like the OSHA (2018) regulations, defines ACMs, including those in school buildings, as "any material which contains more than 1 percent asbestos by weight" (U.S. Congress, 2011). U.S. EPA stated that "[r]emoval of these [in-place asbestos-containing] materials is not usually necessary unless the material is severely damaged or will be disturbed by a building demolition or renovation project" (U.S. EPA, 2020).[41] AHERA also includes a TEM method intended to be used for determining post-abatement clearance after the removal of asbestos from school buildings (as discussed in Section D of the NOA Resource Document), and not for determining risk from any asbestos levels measured with this method. Management of asbestos, including inspections for asbestos, in schools is delegated to state and local agencies (*e.g.*, PADEP, 2021a; U.S. EPA, 1996).[42,43]

4. Does the DOH have recommendations for testing methods and air quality monitoring methods at the site? Is there any difference in cancer risk, or other health risk, associated with the length of the asbestos fiber?

Potential health risks from exposure to asbestos and methods of detecting and quantifying asbestos levels in environmental media are discussed in Sections B, C, D, and F of the NOA Resource Document.

5. Does the DOH have any info on how other states regulate mining in locations that may contain naturally occurring asbestos? Does the DOH have any information on acceptable levels or limits of asbestos in surface water, groundwater, or drinking water?

Identified examples of federal and state regulations surrounding NOA include the following:

- **U.S. EPA:** U.S. EPA has stated that "[a]pproaches for reducing NOA exposure are similar to practices used for asbestos-containing materials in commercial applications" (U.S. EPA, 2008).[44] These approaches consist of engineering controls (*e.g.*, mitigating dust generation, covering or paving heavily travelled NOA-containing areas) and institutional controls (*e.g.*, local laws and permits for work that may disturb NOA, property use restrictions, maintenance plans).
- **Alaska:** The Alaska Department of Environmental Conservation (AKDEC) has stated that "[n]aturally occurring asbestos is harmless unless disturbed which can cause a potential health hazard" (AKDEC, 2021).[45] AKDEC does not provide any information on protocols for mining in areas of the state with NOA.

[39] National Institute for Occupational Safety and Health (NIOSH). 2011. "Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research (Revised Edition)." DHHS (NIOSH) Publication No. 2011-159; NIOSH Current Intelligence Bulletin 62. 174p., April. Accessed at https://www.cdc.gov/niosh/docs/2011-159/pdfs/2011-159.pdf?id=10.26616/NIOSHPUB2011159.

[40] U.S. Congress. 2011. "Subchapter II - Asbestos Hazard Emergency Response." Government Publishing Office (GPO) 15 USC Chapter 53 Subchapter II 2641-2660. p1654-1668.

[41] U.S. EPA. 2020. "Asbestos and school buildings." Accessed at https://www.epa.gov/asbestos/asbestos-and-school-buildings.

[42] Pennsylvania Department of Environmental Protection (PADEP). 2021. "Asbestos." Accessed at https://www.dep.pa.gov/Business/Air/BAQ/BusinessTopics/Pages/Asbestos.aspx.

[43] U.S. EPA. 1996. "How to Manage Asbestos in School Buildings: The AHERA Designated Person's Self Study Guide." EPA-910-B-96-0, January. Accessed at http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Business%20Topics/Asbestos/ahera_ssg.pdf.

[44] U.S. EPA. 2008. "Naturally Occurring Asbestos: Approaches for Reducing Exposure." Office of Superfund Remediation and Technology Innovation, March. Accessed at https://nepis.epa.gov/Exe/ZyPDF.cgi/P1005HTF.PDF?Dockey=P1005HTF.PDF.

[45] Alaska Department of Environmental Conservation (AKDEC). 2021. "Naturally occurring asbestos in Alaska." Division of Air Quality. Accessed at https://dec.alaska.gov/air/anpms/asbestos/natural.

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- **Virginia:** NOA is not mined in Fairfax County, Virginia, but NOA is present in some of the bedrock underlying this heavily populated area (Fairfax County, Virginia, 2021).[46] While construction is permitted in areas with NOA-containing bedrock, when new construction or other activities involving major earth-moving are taking place in these areas, the County mandates that "proper precautions… be taken to control the risk of releasing airborne fibers" (Fairfax County, Virginia, 2021). Such precautions include dust management, air monitoring, personal protective equipment for workers, securing the site, and proper disposal of any asbestos-contaminated materials (Fairfax County, Virginia, 2021).
- **Washington:** At the Sumas Mountain Asbestos Site, NOA was exposed during a landslide, so potential risks to the public were not related to mining activities, but rather to windborne dust and direct contact with the NOA-containing material (WADOH, 2008).[47] Environmental investigations at this site are ongoing, but WADOH's recommendations have thus far primarily consisted of avoiding contact with the material (WADOH, 2008).

Water Limits:

- U.S. EPA has issued an enforceable MCL for asbestos of 7 million fibers longer than 10 μm per liter of drinking water (U.S. EPA, 2020).[48]
- The residential and non-residential groundwater asbestos limit in Pennsylvania is 7 million fibers per liter and is specific to fibers ≥10 μm (PADEP, 2021b).[49] The basis of this limit is the U.S. EPA MCL.

6. Is the DOH aware of any health studies conducted around quarries that contain incidental naturally occurring asbestos and the actual exposure to asbestos that occurred within the surrounding area?

There is a series of epidemiological and environmental studies regarding asbestos exposure from a quarry in Biancavilla (Sicily, Italy) (*e.g.*, Bruni *et al.*, 2014).[50] However, this quarry and the surrounding area has considerable asbestiform fluoro-edenite, which is not present in the Rock Hill Quarry.

Another quarry, more proximate to Rock Hill, located in Sparta, New Jersey (Southdown Quarry, now Cemex) with trace tremolite asbestos was studied by the New Jersey Department of Environmental Protection (NJDEP) and U.S. EPA Region II due to the presence of tremolite in the marble mined at the quarry and detections of tremolite on an air conditioner filter at a residence located downwind of the quarry. Evaluation of lifetime cancer risks, using off-site measured concentrations of asbestos in air, indicated that

[46] Fairfax County, Virginia. 2021. "Construction safety in areas of naturally occurring asbestos." Northern Virginia Soil and Water Conservation District. Accessed at https://www.fairfaxcounty.gov/soil-water-conservation/construction-safety-naturally-occurring-asbestos.

[47] Washington State Dept. of Health (WADOH). 2008. "Health Consultation: Evaluation of Health Statistics and Public Health Data Gaps Related to Exposure to Naturally Occurring Asbestos from Swift Creek, Swift Creek Sediment Asbestos Site, Everson, Whatcom County, Washington." February 22. Accessed at https://www.doh.wa.gov/Portals/1/Documents/Pubs/334-155.pdf.

[48] U.S. EPA. 2020. "National Primary Drinking Water Regulations." February 14. Accessed at https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations#four.

[49] Pennsylvania Department of Environmental Protection (PADEP). 2021b. "Statewide Health Standards." Accessed at https://www.dep.pa.gov/Business/Land/LandRecycling/Standards-Guidance-Procedures/Pages/Statewide-Health-Standards.aspx

[50] Bruni, BM; Soggiu, ME; Marsili, G; Brancato, A; Inglessis, M; Palumbo, L; Piccardi, A; Beccaloni, E; Falleni, F; Mazziotti Tagliani, S; Pacella, A. 2014. "Environmental concentrations of fibers with fluoro-edenitic composition and population exposure in Biancavilla (Sicily, Italy)." *Ann. Ist. Super. Sanita.* 50(2):119-26. doi: 10.4415/ANN_14_02_03.

they are well within the range that is generally considered acceptable by NJDEP and U.S. EPA (2×10^{-6} to 3×10^{-5}) (Lioy *et al*., 2002).[51]

7. Does the DOH make a distinction between different actinolite varieties – the more common prismatic, bladed form, or the less common fibrous form? Additionally, does the DOH make any distinction regarding the length and/or aspect ratio of either the bladed (cleavage fragment) or fibrous forms?

The distinction between asbestiform and other habits of amphibole and serpentine minerals is specified in all U.S. regulatory policy regarding asbestos, in which only the asbestiform varieties are regulated (as discussed further in Sections A, C, and F of the NOA Resource Document). Other, non-asbestiform habits of amphibole and serpentine minerals were explicitly excluded from the regulations by U.S. EPA in 1986 (U.S. Congress, 2011), OSHA in 1992 (OSHA, 1992),[52] and MSHA in 2008 (MSHA, 2008).

8. Does DOH have an opinion regarding the best (EPA) method to test for asbestos in rock, soil, water and air? Is there a preference for optical microscopy methods (PLM and PCM) versus transmission electron microscopy (TEM)?

Methods for the identification and quantification of asbestos levels in environmental media are discussed in Sections C and D of the NOA Resource Document.

9. Can DOH refer to a specific standard or definition for asbestos? Currently the DEP is receiving differing opinions from different experts regarding what should and should not be counted as asbestos. DOH should refer to the USGS (https://pubs.usgs.gov/of/2002/of02-149/of02-149.pdf) definitions of asbestos, for example:

See Sections A, C, and F of the NOA Resource Document for the regulatory definition of asbestos.

[51] Lioy, P; Zhang, J; Freeman, N; Yiin, LM; Hague, R; Lee, RJ; Berman, W; Stern, AH. 2002. "Sparta Township Environmental Asbestos Study: Final Report of the Results of Air and House Dust Sampling." Environmental and Occupational Health Sciences Institute (EOHSI), R.J. Lee Group, EMS Laboratories, Areolas Inc., New Jersey Department of Environmental Protection (NJDEP), U.S. EPA Region II. 86p., October 4.

[52] Occupational Safety and Health Administration (OSHA). 1992. "Occupational exposure to asbestos, tremolite, anthophyllite and actinolite (Final rule)." *Fed. Reg.* 57(110):24310-24331. 29 CFR 1910; 29 CFR 1926, June 8.